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MISCELLANEOUS ISSUES
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CHAPTER 39

THE DIFFUSION OF HEART TRANSPLANTATION: RESULTS OF A SURVEY OF HOSPITALS WITH OPEN-HEART SURGERY FACILITIES

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A. INTRODUCTION

At the Fourth Annual Scientific Session of the International Society for Heart Transplantation in New York on May 5 and 6, 1984, several leading heart transplant surgeons expressed concern about the proliferation of heart transplant programs in the United States. Dr. Jack G. Copeland in his presidential address feared a possible repeat of 1968 when many inexperienced surgeons throughout the world undertook one or more heart transplants. Although according to all standards, no surgeon in 1968 was really "experienced" in clinical heart transplantation, some teams, most notably that of Shumway at Stanford and Lower at the Medical College of Virginia had amassed considerable laboratory experience. To this day, such experience is considered vital to the conduct of clinical heart transplantation.

With the resurgence of interest in heart transplantation have come concerns such as those voiced by Copeland and other members of the cardiac transplantation community. Interestingly, a series of related questions are now discussed more than casually. Among them are the following: How many programs are sufficient to meet the need for heart transplantation? With the proliferation of centers in a small geographic area, how will the available donor hearts be distributed? What is the optimal number of transplants a team should perform over the course of a year? Will patient selection criteria be relaxed with an increased number of programs? What kinds of qualifications should a surgeon have to undertake heart transplantation? What medical specialties should be represented on the cardiac transplant team? And, finally, who will pay for the procedures if they are performed?

Clearly, heart transplantation has the potential to alter the practice of cardiovascular surgery in the U.S. Yet the questions raised here are prototypical of those the entire medical profession will be asked to address over the next decade.

The primary objective of this chapter is to consider what constitutes a heart transplant program, to describe how several major figures in transplant surgery view various sorts of provider restrictions, and finally, to present the results of a national survey of all hospitals in the U.S. with open-heart surgery facilities (N = 648). The purpose of the survey, conducted in collaboration with the American Hospital Association (AHA), was to obtain an accurate estimate of the number of hospitals that are likely to become involved in heart transplantation over the next five years. In the survey, data were also obtained on each institution's experience with heart transplantation and open-heart surgery as well as the representation of various medical specialties on their staff and the manner in which key institutional decisions are made.

Before presenting the results of the survey, however, it is important to provide a general context within which the results can be interpreted. Although there may be a reasonable basis for restricting the diffusion of heart transplantation, there are clearly limitations in the feasibility of this. The legal implications of various provider restrictions have been discussed at great length in Chapter 34. The implications of these and other possible constraints on the restriction of heart transplant activity are discussed below.

B. THE RESTRICTION OF HEART TRANSPLANT ACTIVITY

As alluded to earlier, commentators have expressed concern that unrestrained reimbursement for heart transplantation could lead to the proliferation of inadequately equipped transplant facilities, or the rapid influx of insufficiently trained personnel into the field. Even with the absence of funds, the shortage of donor organs, as well as adequately trained staff members has led to calls for regulating where and by whom heart transplants may be performed (Moore, 1982).

In the past, regulation of medical providers has taken a variety of forms, most notably state certificate-of-need programs that have attempted to limit the capital acquisitions of providers, such as hospitals, in order to achieve overall cost containment (McGregor and Pelletier, 1978; Luft et al., 1979; Finkler, 1979). Financial incentives also have been used under the Federal Section 1122 program (P.L. 92-603) and in some Blue Cross plans (Salkever and Bice, 1976; 1979). Under such controls, institutions that do not receive prior approval for investment projects may be denied reimbursement for the costs of those projects. Even under the End-Stage Renal Disease (ESRD) program, the Federal government has attempted to limit the number of dialysis facilities and the number of hospitals doing transplants by specifying minimum utilization rates that must be met in order to receive reimbursement (see Appendix 39-A).

Except in the ESRD case, these regulations have been aimed more at particular medical equipment or facilities and not at specific medical procedures. For example, open-heart facilities in hospitals have been subject to certificate-of-need requirements, but this covers a wide

variety of surgical procedures. Heart transplantation provides a different situation in that many hospitals already have the appropriate facilities and need only the required skilled physicians and other personnel. Moreover, aside from general licensure requirements, no special credentials are required of the surgeon or the other members of the transplant team. At the present time, therefore, there are virtually no restrictions on who may perform heart transplants or on hospitals or medical centers that decide to undertake a heart transplantation program once they have acquired the necessary open-heart facilities.

Nonetheless, there is some expectation that the surgeon performing heart transplants has had some experience with the procedure and, if not, that he or she is quite familiar with transplant surgery and immunology. In addition, there are other generally recognized informal requirements for a cardiac transplantation program. These requirements have been outlined by Copeland and Stinson (1979) and are reproduced in Table 39-1.

For reasons primarily associated with efficiency and safety issues, the approach of placing some limitation on providers appears to have the endorsement of key figures in the organ transplant community. For example, Francis Moore (1980), a pioneer in transplant surgery, in bemoaning the fact that the Boston area lacked a heart transplant program, made the following statement in a letter to the New England Journal of Medicine following the public declaration that Massachusetts General Hospital would not permit heart transplants to be done at that institution (Leaf, 1980):

Table 39-1
Requirements for a Cardiac Transplantation Program

(1) Clearance and education
- a. Hospital administration
- b. Hospital staff
  - Surgery, neurosurgery, neurology, anesthesia
- c. Nursing
- d. Psychiatry, social service goals, counseling techniques
- e. Physical resources
  - Room cleaning, room modification
- f. County coroner

(2) Explicit protocol
- a. Donor--brain death criteria
- b. Recipient
  - Preoperative identification
  - Postoperative care
  - Antithymocyte globulin availability
- c. Nursing care
  - Isolation techniques

(3) Transplant team experience and background
- a. The operation
  - Surgeon's experience
  - Operating room personnel
- b. Heart biopsy
  - Technique
  - Histologic criteria of rejection
- c. EKG monitoring
- d. Treatment of rejection
- e. Continuous availability of physician for clinical care of recipients
- f. Heart procurement
  - In-hospital
  - Long-distance transport

(4) Community
- a. Education of referring physicians
  - Donors
  - Recipients
- b. Education of lay public
  - Organ donation
- c. The press
  - Hospital news bureau
  - Protection of privacy
    - Patients
    - Physicians

SOURCE: Copeland and Stinson, 1979.

> In a nation this size, there should be four or five centers where heart and liver transplantation can be performed competently. The historical position of Boston in transplant surgery, immunology, cardiology, and hepatology, along with its record of close collaboration between the laboratory and clinic and between disciplines (medicine, surgery, and pathology), recommends it as a center to complement the remarkably fruitful work in California and Richmond on heart transplantation and in Colorado and Cambridge (England) on liver transplantation. Several hospitals in Boston should share this responsibility, working together without competition.

More recently Moore has restated his position, again recommending that heart transplantation be undertaken at selected institutions, regardless of cost (Moore, 1982). He states that:

> the distribution of donors, as well as the presumably equivalent distribution of potential recipients, however, mandates the wider availability of cardiac transplantation.
>
> ...The United States should have a reasonable distribution of major centers to provide remarkable services for rare diseases, no matter what those diseases are and no matter how much the treatment costs.

Moore recommends that the distribution of centers should coincide approximately with the census districts or Army Corps areas. He further notes that "there should be nine or ten centers in this country with the teams, cardiologic backup, cadaver donor procurement capability and experience, and the cardiac surgical team expertise to make cardiac transplantation available to those who need it."

Copeland and Stinson (1979) have provided advice on the initiation of new cardiac transplantation programs that also suggests that heart transplantation should be performed on a restricted basis at selected centers. They caution that new programs should be initiated "only

after serious consideration of the current state-of-the-art," and further note:

> The most important single factor in beginning such a new undertaking at an institution lacking in previous experience with cardiac transplantation should be detailed protocol outlining each step in the entire process. If results similar to those obtained at Stanford are expected, it would seem logical to rely heavily on the techniques mentioned in this or other articles for the construction of such a protocol. Observation of a successful transplantation program and acquisition of skills in the techniques of orthotopic cardiac transplantation and percutaneous endomyocardial biopsy should also be absolute requirements. Communication, education and discussion with the hospital administration, the hospital staff, nursing staff and ancillary personnel constitute important groundwork, which should be covered well in advance of the initial transplantation procedure.

In preparing for the National Heart Transplantation Study, the Health Care Financing Administration sought the advice of the National Heart, Lung, and Blood Institute (NHLBI) that, in turn, convened an advisory group of experts in cardiology, cardiovascular surgery, organ transplantation, and immunology. The criteria established by this advisory group were then furnished to the Health Care Financing Administration by the now defunct National Center for Health Care Technology (Perry, 1982a; 1982b; Sun, 1983). These criteria, with the exception of one which required that institutions applying for funding under the National Heart Transplantation Study have had experience with a clinical heart transplant program within the past five years, are reproduced in Table 39-2. These criteria are obviously somewhat more detailed than those provided in Table 39-1, and they reflect the fact that cardiac transplantation cannot be considered simply as a

Table 39-2
Requirements For a Cardiac Transplantation Program as Specified by the National Heart, Lung, and Blood Institute's Special Advisory Group

(1) The institution must have adequate patient selection criteria.

a. Patient selection criteria are to be based upon both critical medical need for transplantation and maximum likelihood of successful clinical outcome.

b. The institution selects patients that have a very poor prognosis (e.g., less than 10-25 percent likelihood of survival for six months) as a result of poor cardiac functional status.

c. All other medical and surgical therapies have been considered or tried that might be expected to yield improvement and a one-year survival comparable to that of cardiac transplantation.

d. Patient selection criteria give consideration to those factors that are recognized at the present time as exerting an adverse influence on the outcome after cardiac transplantation (see below).

(2) The institution must have adequate patient management plans and protocols that include the following:

a. Detailed plans for the therapeutic and evaluative procedures for the acute and long-term management of a patient, including commonly encountered complications.

b. The basis for confidence in the proposed therapeutic and evaluative regimen.

c. The logistics of the plans for patient management and evaluation during the waiting and immediate post-discharge, as well as in-hosptal, phases of the program.

d. The logistics of the plans for the long-term management and evaluation including education of the patient and liaison with the patient's permanent physician.

Table 39-2 (Continued)
Requirements For a Cardiac Transplantation Program as Specified
by the National Heart, Lung, and Blood Institute's
Special Advisory Group

(3) The institution must have a sufficient commitment of resources and planning to the heart transplant program. Indications of such commitment could include the following:

a. Commitment of the institution to the heart transplant program is at all levels and broadly evident throughout the institution. (A cardiac transplantation program requires a major commitment of resources. These may intermittently include many other departments as well as the principal sponsoring departments.)

b. There are both the expertise and the commitment for participation in the medical, surgical, and other relevant areas, particularly cardiology, cardiovascular surgery, anesthesiology, immunology, infectious diseases, nursing, neurology/neurosurgery, and social services. In most of these areas, individual persons need to be identified to achieve an identifiable and stable transplant team.

c. The component teams are integrated into a comprehensive team with clearly defined leadership and corresponding responsibility.

d. The institution has an active clinical organ transplantation program involving immunosuppressive techniques and the results of that program. (In the absence of such an active clinical organ transplant program, the institution may have great difficulty in showing that the necessary expertise will be available and logistically feasible.)

e. There is an active cardiovascular, medical, and surgical program. (General indicators of this would be a minimum of 500 cardiac catheterizations and coronary arteriograms annually, with the ability and willingness to do such procedures on an emergency basis, and a surgical group that has demonstrated low mortality rates in an active open-heart surgical program involving at least 250 procedures a year.) The surgical team responsible for transplantation must be an identified, stable group.

f. The anesthesia service is prepared to develop a team for transplantation that will also be available at all times.

Table 39-2 (Continued)
Requirements For a Cardiac Transplantation Program as Specified by the National Heart, Lung, and Blood Institute's Special Advisory Group

g. The infectious diseases service has both professional skills and the laboratory resources that are needed to discover, identify, and manage a whole range of organisms, many of which are uncommonly encountered in the usual infectious diseases laboratory.

h. The nursing service is prepared to develop a team or teams trained not only in hemodynamic support of the patient, but also in the special problems of managing immunosuppressed patients.

i. Pathology resources are available for studying and promptly reporting the pathological responses to transplantation.

j. A neurology or neurosurgery group is available for the donor selection procedures for objective clinical decision on brain death.

k. Adequate social service resources are available.

l. There is a clearly assigned and knowledgeable legal officer familiar with transplantation laws and regulations.

m. Adequate logistical plans exist for organ procurement meeting legal and ethical criteria, as well as yielding viable transplantable organs in reasonable numbers.

SOURCE: Federal Register Vol. 46, No. 14, Pgs. 7072-7074, Thursday, January 22, 1981.

surgical procedure. The Federal Register notice announcing the National Heart Transplantation Study clearly emphasized this (Newman, 1981):

> clinical effectiveness and usefulness are dependent upon careful and appropriate patient selection, expert surgery, postoperative care, immunosuppression, patient education, and liaison with the patient's permanent physician for subsequent lifelong care.

The advisory group to the National Heart, Lung, and Blood Institute further emphasized that the criteria provided in Table 39-2 were to serve as guidelines and "...do not necessarily represent our view as to what procedures are essential to assessing safety and efficacy in the performance of cardiac transplantation."

Based on the ESRD experience and the comments and suggestions above, one can envision many potential forms of regulation. They include: (1) geographic division and restriction of transplant activity; (2) an absolute limit on the number of transplantation centers or surgeons; (3) certification or licensure procedures to assure safety and efficacy, and (4) regulation of the number of transplants that each center or surgeon must (or can) perform.

One possible means of regulating to control safety and efficacy would be to enact state or federal licensure laws for transplant centers and/or surgeons that specify certain standards that must be met before heart transplantation may be undertaken. Geographic networking and restriction of transplant activity may be viewed as a means of attaining efficient distribution of donor organs, as a means of making access to heart transplantation more equitable, and perhaps

of controlling costs by curtailing expansion of transplant activity to other centers. As discussed, a facility or personnel licensure process could also be viewed as a means of promoting efficient use of scarce resources.

An alternate policy may be the refusal to regulate at all. The government could leave the transplant community free to enact their own methods of control. However, the transplant community, as well as medical personnel who wish to enter the field free of restriction, may be either unable or unwilling to regulate or coordinate transplantation activity. In addition, self regulation may raise serious antitrust issues. Government regulation may therefore be the preferred method of undertaking regulation if there is a felt need for limiting and/or coordinating transplant related activity.

If undertaken, the potential reach of regulation could vary tremendously, depending on the means used to regulate. Government regulation of transplantation activity could be limited to: (1) placing conditions on participation in a Medicare reimbursement program, (2) extended to virtually all transplant activity, whether reimbursed or not, through direct state or federal law, or (3) by conditioning receipt of federal monies on compliance with federally mandated standards or limitations.

If Medicare reimbursement does come about, and the government's interests are restricted to controlling reimbursed activity, regulation could be limited to centers or providers who perform reimbursed transplantations. Under this type of a scheme, heart transplant activity that is not reimbursed, or centers that choose to

perform no Medicare reimbursed procedures, would remain unaffected. Under this system, reimbursement would be limited to centers or physicians who meet certain certification requirements. Similarly, the government could put an absolute limit on the number of surgeons who could perform heart transplants or centers at which reimbursed heart transplantation could take place. Currently, however, the law provides that Medicare may not discriminate against any institution, agency, or person qualified to participate in an undertaking to provide reimbursed services (42 U.S.C.§1395a). Another potential condition would require the use of strict patient selection criteria when choosing among patients eligible for Medicare transplantation benefits.

While the limitations suggested above would apply only to reimbursed transplant activity, the government could seek to regulate, via its use of spending power, all heart transplantation activity in hospitals receiving any type of federal financial assistance. For example, receipt of a variety of forms of federal financial assistance could be conditioned on compliance with a certification or licensure system for providers of transplantation services. Conceivably, the federal government could require the states, as a condition of receipt of federal financial assistance, to enact facility or licensure laws or other controls on the availability of a procedure.

State and federal governments could act through direct statutory or administrative regulation as well. For example, a state or the federal government could impose certification or licensure requirements that would apply regardless of the transplant center's or

surgeon's status as recipients of state or federal financial assistance. Similarly, the government could seek to legislatively establish exclusive regional transplant facilities. Finally, at the farthest end of the regulation spectrum, the government could seek to prohibit totally the performance of certain procedures such as heart transplantation. While the latter option is extremely remote, refusing all persons (including those under private insurance) access to a procedure on equity grounds has been noted as an alternative by several commentators (Caminisch, 1979; Childress, 1970).

Against this backdrop we now present the results of a major survey of open-heart surgery facilities in the U.S. As described above, the intent of this survey was to project the number of hospitals that may potentially become involved with heart transplantation over the next five years.

C. DATA AND METHODS

At the outset of the National Heart Transplantation Study we recognized the importance of being able to project the number of medical centers in the U.S. that might embark upon heart transplantation over the next few years. We knew, for example, that the level of heart transplant activity was constrained, not only by the availability of viable donor hearts, but also by the number of active transplant programs. If circumstances changed, we anticipated that the level of transplant activity could increase substantially. For example, we assumed that if third party payers, public and private alike, were to reimburse for heart transplants, that many more medical centers would

take an interest in the procedure and would be likely to start programs.

1. DATA

To answer the many questions that we felt were important, in November, 1983, the Battelle Human Affairs Research Centers entered into a subcontract with the American Hospital Association (AHA) to conduct a survey of all hospitals in the U.S. that had open-heart surgery facilities. The survey was called the "Survey of Open-Heart Surgery Facilities--1983." We generally believed that those hospitals most likely to embark on heart transplantation would be those that already had a commitment to open-heart surgery. Start-up costs at such institutions would be minimal when compared with hospitals that did not have the facilities to perform open-heart surgery. The identification of such facilities was uncomplicated given the fact that the American Hospital Association (AHA) routinely conducts an annual survey of hospitals and maintains a complete census of hospitals with various types of specialized facilities, such as those required for open-heart surgery.

a. Survey Instrument. A brief but comprehensive survey instrument was developed by the staff of the Battelle Human Affairs Research Centers to conduct the "Survey of Open-Heart Surgery Facilities." The survey was cleared by the Office of Management and Budget of the federal government. The survey instrument was applicable to all hospitals with open-heart surgery facilities whether or not they had experience with heart transplantation. For those institutions that were currently performing heart transplants, a

separate set of questions were asked. In this survey, of course, we were more interested in those hospitals that were not now performing but were contemplating heart transplantation. For these hospitals, the questions involved differing scenarios about what it would take for them to initiate a heart transplant program. Most important, we thought, would be a change in the status of the procedure for purposes of reimbursement. It should be noted that at the time of our survey, the Medicare program did not pay for heart transplants nor did many private insurers. Over the past six months, several private insurers have announced that they will reimburse for heart transplants (e.g., Blue Shield of California). This, in turn, has prompted many hospitals to reconsider heart transplantation.

The survey instrument for the Survey of Open-Heart Surgery Facilities is included here as Appendix 39-B. The Executive Summary of the survey is reproduced here as Exhibit 39-1. The purpose of the survey was stated clearly, the universe for the survey was identified, the manner in which the data were to be used was noted, and the person who should complete the questionnaire was identified.

If an institution had previously performed heart transplants, they were asked about the following:

- how many heart transplants had been performed at their institution
- when their first heart transplant was performed
- the year of their most recent transplant
- whether their current program was on a trial basis

Exhibit 39-1
Executive Summary of the Survey of
Open-Heart Surgery Facilities, 1983

PURPOSE:	To obtain an accurate estimate of the number of hospitals that will be involved in heart transplantation procedures throughout the next five years.
UNIVERSE:	All hospitals nationwide which have open-heart surgery facilities as listed by the American Hospital Association's Annual Survey (N=641).
STATISTICAL TECHNIQUES:	Standard descriptive measures and summary statistics (means, standard deviations, correlations, etc.).
DATA USE AND USE TO HOSPITALS:	This survey will aid in establishing baseline information on heart transplantation and its availability throughout the United States. Also, this information will be used to examine the impact of a potential Medicare coverage policy with respect to reimbursement for heart transplantation.
SPONSORSHIP AND FUNDING:	The Department of Survey Research of the American Hospital Association in collaboration with Battelle Human Affairs Research Centers and the Health Care Financing Administration.
RESULTS AVAILABLE TO:	Survey respondents, state and metropolitan hospital associations, and appropriate researchers in the health-care field. Also, on written request, to other registered hospitals.
ESTIMATED TIME TO COMPLETE:	Approximately one hour, depending upon the individual hospital's record-keeping system.
STAFF NEEDED TO COMPLETE:	Chairman, Chief, or Director of the Department of Surgery.

- the number of heart transplants performed in the most recent calendar year
- if they planned to expand their program if Medicare chose to cover the procedure
- how many transplants they would like to perform each year.

Institutions that had not performed heart transplants were asked a separate series of questions that addressed the following:

- whether they were considering heart transplants at the present time
- whether they might consider or reconsider heart transplants in the future
- whether they might consider doing heart transplants within the next five-years
- if Medicare coverage would increase the likelihood that they would start a program
- if any surgeons on their staff had ever performed or assisted with a heart transplant

All institutions were asked a series of questions about their facilities, staff, and decision making process. Data were obtained on the following:

- number of adult open-heart surgical operations performed in 1982
- number of pediatric open-heart surgical procedures performed in 1982
- number of kidney transplants performed in 1982
- number of cardiac catheterizations performed in 1982
- number of full-time equivalents in each of the following medical specialties: anesthesiology, cardiology, cardiovascular surgery, immunology,

infectious diseases, neurology, neurosurgery, pathology, transplant surgery, and virology

- whether they had an organ procurement program
- which groups of individuals must approve a heart transplant program: Department of Surgery, Chief of Medical Staff, Hospital Administration, Board of Trustees, and others

Taken together, these questions provide the basis for the analyses undertaken here. They enable us to examine the plans of existing transplant programs and to anticipate the activities of other hospitals with open-heart surgery facilities.

b. Survey Protocol. A brief description of the survey protocol has been provided to Battelle by Gentile (1984). Essential aspects of that protocol are described here based on Gentile's report.

During the second week of January, 1984, the Department of Special Studies, of the Office of Public Policy Analysis, of the American Hospital Association mailed the Survey of Open Heart Surgery Facilities to 648 institutions in the United States, including Puerto Rico. Gentile (1984) notes that "Response from participating hospitals was encouraging from the very beginning." Forty-three percent of all hospitals responded to the first mailing of the questionnaire.

On February 29, 1984 a second questionnaire was mailed to those institutions that failed to respond to the first questionnaire. Given the enthusiastic response to the first mailing, it was expected that the overall survey response rate would be excellent. Gentile (1984) notes that "Most AHA surveys receive approximately 25 to 30 percent response rate for the first mailing." At the close of the

survey period, a final response rate of 80.7 percent was achieved. Greater detail on the response rate is provided below.

c. Response Rate. Gentile (1984) has described in some detail what he refers to as the "demographics of response" which amounts to an attempt to determine, insofar as possible, whether those hospitals that failed to respond to the questionnaire differed from those that responded. As noted above, 648 institutions were listed on the AHA Annual Survey as having open-heart surgery facilities. Of these institutions, 523 or 80.7 percent responded to our survey. Table 39-3 outlines the response rate by U.S. Census Region. As shown, the response rate is fairly consistent throughout the nation with a slightly lower rate of response in the West South Central states. When examining whether the responding institutions differed from the nonrespondents, hospital bed size is a key consideration. As shown in Table 39-4, both the respondents and nonrespondents are nearly identical suggesting that the nonrespondents do not differ from the respondents.

Not surprisingly, all the hospitals that indicated they had open-heart surgery facilities were of at least 50 beds. Moreover, when examining survey response by who controls the hospital (e.g., government, nongoverment, etc.) we find that over 90 percent of the federal facilities responded to the survey (see Table 39-5).

2. METHODS

As noted above, not every institution that may consider embarking on heart transplantation is necessarily qualified to do so. The leaders in the field have provided guidelines for the

Table 39-3
Survey Response By U.S. Census Region

U.S. CENSUS REGION	NUMBER OF INSTITUTIONS	RESPONDENTS	NON-RESPONDENTS	RESPONSE RATE
Puerto Rico	4	4	0	100.0
New England	24	21	3	87.5
Middle Atlantic	76	60	16	78.9
South Atlantic	95	76	19	80.0
East North Central	117	98	19	83.8
East South Central	41	33	8	80.5
West North Central	57	45	12	78.9
West South Central	84	60	24	71.4
Mountain	42	36	6	85.7
Pacific	108	90	18	83.3
U.S. TOTAL	648	523	125	80.7

Table 39-4
Survey Response By Bed Size of Hospital

BED SIZE	NUMBER OF INSTITUTIONS	NUMBER OF RESPONDENTS	NUMBER OF NONRESPONDENTS	RESPONSE RATE
50 - 99	5	4	1	80.0
100 - 199	40	33	7	82.5
200 - 299	94	78	16	83.0
300 - 399	107	86	21	80.4
400 - 449	125	96	29	76.8
500+	277	226	51	81.6
U.S. TOTAL	648	523	125	80.7

Table 39-5
Survey Response By Who Controls The Hospital

CONTROL TYPE	NUMBER OF INSTITUTIONS	NUMBER OF RESPONDENTS	NUMBER OF NONRESPONDENTS	RESPONSE RATE
Government, Non-Federal	91	70	21	76.9
Nongovernment, Not-for-Profit	472	378	94	80.1
Nongovernment, Investor-Owned	34	28	6	82.4
Government, Federal	51	47	4	92.2
U.S. TOTAL	648	523	125	80.7

establishment of a heart transplant program. In reporting the results of our survey, we have ordered institutions hierarchically in terms of the extent to which they fit very minimal criteria. The procedures we have followed to do this are described below. In addition, it should be noted that the manner in which the data are analyzed is largely descriptive. Our approach to the analysis of the data is also discussed below.

a. Classification of Open-Heart Surgery Facilities. The first step in our approach to data analysis has been to classify open-heart surgery facilities based on the extent to which they meet various requirements of a model heart transplant program. This is both a difficult and controversial task. In recognition of this, we have developed a taxonomy of open-heart surgery facilities based on the extent to which they meet strong as well as weak criteria. Our intent is to provide a basis for deciding how many institutions satisfy various requirements for a program. We have presented the results in a manner that will enable interested parties to vary assumptions and then determine how many institutions are qualified to perform heart transplants. We have also classified those active heart transplant programs that responded to our survey within our taxonomy.

Our taxonomy makes several assumptions about the requirements for a heart transplant program. In our judgement, it is desirable for any institution performing or considering heart transplantation to meet the following minimal requirements:

- perform at least 100 open-heart surgery procedures per year, preferably 250 or more

- perform at least 350 cardiac catheterizations per year, preferably 500 or more
- have at least a greater than zero full-time equivalent of each of the following medical specialties: anesthesiology, cardiology, cardiovascular surgery, neurology or neurosurgery, and pathology

It is most desirable if an institution meets the following requirements:

- performs 250 or more open-heart surgery procedures per year
- has an active kidney transplant program or has transplant surgeons on their staff or has a surgeon who has performed or assisted with a heart transplant (hereafter we refer to this requirement as "transplantation experience")
- performs 500 or more cardiac catheterizations per year
- has at least a greater than zero full-time equivalent of each of the following specialties: anesthesiology, cardiology, cardiovascular surgery, immunology, infectious diseases or virology, neurology or neurosurgery, and pathology.

Recognizing the considerable variation in procedures performed and staffing patterns, we have developed a taxonomy consisting of eight "classes" of institutions with four "levels" within each class. Before discussing the major classes of institutions, we identify the "generic class criteria." Classes differ in the extent to which institutions meet these generic class criteria. A Class I institution, the highest class, must:

- have transplantation experience

. have at least a greater than zero full-time equivalent of each of the following medical specialties: anesthesiology, cardiology, cardiovascular surgery, immunology, infectious diseases or virology, neurology or neurosurgery, and pathology.

While a Class I institution meets all these requirements, in addition to certain "level" criteria, the other classes of institutions vary in the extent to which they do so.

The assumptions we have used to distinguish among classes are very simple. First and foremost we believe experience with organ transplantation is extremely important in starting a heart transplant program. Next in importance is the availability of an immunologist, since rejection is the most significant problem the transplant recipient confronts. Finally, we place special emphasis on infectious disease specialists or virologists because the next most significant problem that transplant recipients face is infection. We rank institutions with transplantation experience higher than those without. However, institutions with no immunologists or infectious disease specialists rank lower than those with transplantation experience and immunologists and infectious disease specialists. For this reason, institutions with transplant experience, but no immunologists or infectious disease specialists/virologists are Class IV and an institution with no transplant experience but having immunologists and infectious disease specialists/virologists are Class V.

The eight classes of institutions are as follows:

Class I Institutions that meet all the generic class criteria.

Class II — Institutions that meet all the generic class criteria but have no infectious disease specialists or virologists.

Class III — Institutions that meet all the generic class criteria but have no immunologists.

Class IV — Institutions that meet all the generic class criteria but have no infectious disease specialists, virologists, or immunologists

Class V — Institutions that meet all the generic class criteria but have no transplantation experience.

Class VI — Institutions that meet all the generic class criteria but have no transplantation experience, and have no infectious disease specialists or virologists.

Class VII — Institutions that meet all the generic class criteria but have no transplantation experience, and have no immunologists.

Class VIII — Institutions that meet all the generic class criteria but have no transplantation experience, have no infectious disease specialists or virologists, and have no immunologists.

Above we have also noted that institutions may differ in the extent to which they meet various "level" criteria. For example, they may differ with regards to the number of open-heart surgery procedures and catheterizations they perform. For this reason, we have distinguished among four levels of institutions that fit within each of the classes. The levels are as follows:

Level A. An institution that performs at least 250 open-heart surgery procedures and at least 500 cardiac catheterizations per year.

Level B. An institution that performs at least 250 open-heart surgery procedures and between 350 and 499 cardiac catheterizations per year.

Level C. An institution that performs between 100 and 249 open-heart surgery procedures and at least 500 cardiac catheterizations per year.

Level D. An institution that performs between 100 and 249 open-heart surgery procedures and between 350 and 499 cardiac catheterizations per year.

Levels are distinguished according to both the level of difficulty and volume of procedures performed.

Based on this overall scheme, the most qualified institution to undertake heart transplantation would be Class I, Level A. The least qualified institution is not necessarily Class VIII, Level D, however. If an institution does not have a greater than zero full-time equivalent anesthesiologist, cardiologist, cardiovascular surgeon, neurologist or neurosurgeon it is automatically assigned to Class 0, regardless of the number of open-heart surgical procedures and cardiac catheterizations it performs. Also, if an institution failed to supply us with the data required to classify them, then they too were classified as Class 0. Thus, Class 0 is composed of institutions that failed to meet our classification criteria or failed to provide the data we needed to classify them. Therefore, it is possible that some institutions in Class 0, may be legitimately placed in another class if we had complete data for them.

Tables 39-6 through 39-13 depict simplistically the criteria that the various classes of institutions (by level) are required to meet.

Table 39-6
Criteria For Class I Institutions

	CLASS I			
CRITERION	A	B	C	D
Open-heart surgical procedures	≥250	≥250	QQ	QQ
Transplantation experience	>0	>0	>0	>0
Cardiac Catheterization	≥500	PP	≥500	PP
Anesthesiologists	>0	>0	>0	>0
Cardiologists	>0	>0	>0	>0
Cardiovascular surgeons	>0	>0	>0	>0
Immunologists	>0	>0	>0	>0
Infectious Disease or Virologists	>0	>0	>0	>0
Neurologist or Neurosurgeon	>0	>0	>0	>0
Pathologist	>0	>0	>0	>0

PP = less than 500 but greater than 350

QQ = less than 250 but greater than 100

SIMPLE CLASS DESCRIPTION:
HAS TRANSPLANTATION
HAS INFECTIOUS DISEASE
HAS IMMUNOLOGY

Table 39-7
Criteria For Class II Institutions

	CLASS II			
CRITERION	A	B	C	D
Open-heart surgical procedures	≥250	≥250	QQ	QQ
Transplantation experience	>0	>0	>0	>0
Cardiac Catheterization	≥500	PP	≥500	PP
Anesthesiologists	>0	>0	>0	>0
Cardiologists	>0	>0	>0	>0
Cardiovascular surgeons	>0	>0	>0	>0
Immunologists	>0	>0	>0	>0
Infectious Disease or Virologists	=0	=0	=0	=0
Neurologist or Neurosurgeon	>0	>0	>0	>0
Pathologist	>0	>0	>0	>0

PP = less than 500 but greater than 350

QQ = less than 250 but greater than 100

SIMPLE CLASS DESCRIPTION:
HAS TRANSPLANTATION
HAS IMMUNOLOGY
NO INFECTIOUS DISEASE

Table 39-8
Criteria For Class III Institutions

	CLASS III			
CRITERION	A	B	C	D
Open-heart surgical procedures	≥250	≥250	QQ	QQ
Transplantation experience	>0	>0	>0	>0
Cardiac Catheterization	≥500	PP	≥500	PP
Anesthesiologists	>0	>0	>0	>0
Cardiologists	>0	>0	>0	>0
Cardiovascular surgeons	>0	>0	>0	>0
Immunologists	=0	=0	=0	=0
Infectious Disease or Virologists	>0	>0	>0	>0
Neurologist or Neurosurgeon	>0	>0	>0	>0
Pathologist	>0	>0	>0	>0

PP = less than 500 but greater than 350

QQ = less than 250 but greater than 100

SIMPLE CLASS DESCRIPTION:
HAS TRANSPLANTATION
HAS INFECTIOUS DISEASE
NO IMMUNOLOGY

Table 39-9
Criteria For Class IV Institutions

	CLASS IV			
CRITERION	A	B	C	D
Open-heart surgical procedures	≥250	≥250	QQ	QQ
Transplantation experience	>0	>0	>0	>0
Cardiac Catheterization	≥500	PP	≥500	PP
Anesthesiologists	>0	>0	>0	>0
Cardiologists	>0	>0	>0	>0
Cardiovascular surgeons	>0	>0	>0	>0
Immunologists	=0	=0	=0	=0
Infectious Disease or Virologists	=0	=0	=0	=0
Neurologist or Neurosurgeon	>0	>0	>0	>0
Pathologist	>0	>0	>0	>0

PP = less than 500 but greater than 350

QQ = less than 250 but greater than 100

SIMPLE CLASS DESCRIPTION:
HAS TRANSPLANTATION
NO IMMUNOLOGY
NO INFECTIOUS DISEASE

Table 39-10
Criteria For Class V Institutions

	CLASS V			
CRITERION	A	B	C	D
Open-heart surgical procedures	≥250	≥250	QQ	QQ
Transplantation experience	=0	=0	=0	=0
Cardiac Catheterization	≥500	PP	≥500	PP
Anesthesiologists	>0	>0	>0	>0
Cardiologists	>0	>0	>0	>0
Cardiovascular surgeons	>0	>0	>0	>0
Immunologists	>0	>0	>0	>0
Infectious Disease or Virologists	>0	>0	>0	>0
Neurologist or Neurosurgeon	>0	>0	>0	>0
Pathologist	>0	>0	>0	>0

PP = less than 500 but greater than 350

QQ = less than 250 but greater than 100

SIMPLE CLASS DESCRIPTION:
NO TRANSPLANTATION
HAS IMMUNOLOGY
HAS INFECTIOUS DISEASE

Table 39-11
Criteria For Class VI Institutions

	CLASS VI			
CRITERION	A	B	C	D
Open-heart surgical procedures	≥250	≥250	QQ	QQ
Transplantation experience	=0	=0	=0	=0
Cardiac Catheterization	≥500	PP	≥500	PP
Anesthesiologists	>0	>0	>0	>0
Cardiologists	>0	>0	>0	>0
Cardiovascular surgeons	>0	>0	>0	>0
Immunologists	>0	>0	>0	>0
Infectious Disease or Virologists	=0	=0	=0	=0
Neurologist or Neurosurgeon	>0	>0	>0	>0
Pathologist	>0	>0	>0	>0

PP = less than 500 but greater than 350

QQ = less than 250 but greater than 100

SIMPLE CLASS DESCRIPTION:
NO TRANSPLANTATION
HAS IMMUNOLOGY
NO INFECTIOUS DISEASE

Table 39-12
Criteria For Class VII Institutions

	CLASS VII			
CRITERION	A	B	C	D
Open-heart surgical procedures	≥250	≥250	QQ	QQ
Transplantation experience	=0	=0	=0	=0
Cardiac Catheterization	≥500	PP	≥500	PP
Anesthesiologists	>0	>0	>0	>0
Cardiologists	>0	>0	>0	>0
Cardiovascular surgeons	>0	>0	>0	>0
Immunologists	=0	=0	=0	=0
Infectious Disease or Virologists	>0	>0	>0	>0
Neurologist or Neurosurgeon	>0	>0	>0	>0
Pathologist	>0	>0	>0	>0

PP = less than 500 but greater than 350

QQ = less than 250 but greater than 100

SIMPLE CLASS DESCRIPTION:
NO TRANSPLANTATION
HAS INFECTIOUS DISEASE
NO IMMUNOLOGY

Table 39-13
Criteria For Class VIII Institutions

	CLASS VIII			
CRITERION	A	B	C	D
Open-heart surgical procedures	≥250	≥250	QQ	QQ
Transplantation experience	=0	=0	=0	=0
Cardiac Catheterization	≥500	PP	≥500	PP
Anesthesiologists	>0	>0	>0	>0
Cardiologists	>0	>0	>0	>0
Cardiovascular surgeons	>0	>0	>0	>0
Immunologists	=0	=0	=0	=0
Infectious Disease or Virologists	=0	=0	=0	=0
eurologist or Neurosurgeon	>0	>0	>0	>0
Pathologist	>0	>0	>0	>0

PP = less than 500 but greater than 350

QQ = less than 250 but greater than 100

SIMPLE CLASS DESCRIPTION:
NO TRANSPLANTATION
NO IMMUNOLOGY
NO INFECTIOUS DISEASE

b. Analysis Procedures. As noted above, the analysis of the data from our survey of open-heart surgery facilities is highly descriptive. Our intent is simply to characterize those institutions that are currently involved in heart transplantation or are considering the initiation of a program. Initially we report various results for all institutions participating in our survey. Next we report the results as they pertain to seven respondent groups. These groups range from institutions currently performing heart transplants to those that said they would be doing so within the next five years, if Medicare funding were to become available to pay for them. Finally, we analyze the institutions by region of the country according to the criteria set forth above in an attempt to understand to what extent they "qualify" to perform heart transplant procedures. A listing of the states within region is provided in Appendix 39-C.

D. RESULTS

1. DESCRIPTION OF HOSPITALS RESPONDING TO THE SURVEY

For both historical and descriptive purposes, we asked each institution responding to our survey to indicate in what year they began doing open-heart surgery. Sixty-two or 11.9 percent of the institutions were unable to answer this question, presumably because they did not know. As shown in Table 39-14, of those institutions that did know, the vast majority performed their first procedure between 1971 and 1975. Only 38 institutions performed their first procedure between 1981 and 1983, with only 4 institutions doing so in 1983.

Table 39-14
Year In Which Participating Institutions Began
Open-Heart Surgery

YEAR	NUMBER OF INSTITUTIONS	PERCENT OF INSTITUTIONS
1950-55	13	2.5
1956-60	96	18.4
1961-65	46	8.8
1966-70	74	14.1
1971-75	114	21.8
1976-80	80	15.3
1981-83	38	7.3
UNKNOWN	62	11.9

Above we have demonstrated that the nonrespondents to our survey of open-heart surgery facilities do not differ from the respondents in terms of hospital size, region of the country, or the organization by which they are controlled. We will now describe the respondents in terms of other characteristics, in particular, the number of various types of procedures performed, number of persons of various medical specialties that are on the institution's staff, the availability of an organ procurement program, and groups or persons that must approve major policy decisions, such as embarking upon a heart transplantation program.

Table 39-15 shows the descriptive statistics for a variety of procedures performed by the participating institutions. As shown, there is considerable variation among institutions with regard to each of these procedures. Of the 523 institutions that participated in the survey, 507 reported that they had performed adult open-heart surgical procedures in 1982. Of these 507 institutions, 20 or 3.9 percent did not perform any of these procedures. The average number of procedures performed at those institutions that did one or more adult cases was 357.2 (S.D. = 362.2), although the range was between 1 and 4,202. The median number of procedures was 269.0. Table 39-16 provides more detailed data on the total volume of open-heart surgery at all institutions.

Pediatric open-heart surgical procedures are more specialized than those for adults, with the majority of these procedures performed at childrens' hospitals. As shown in Table 39-17, of the 404 institutions that provided data on pediatric procedures, 250 or 61.9

Table 39-15
Descriptive Statistics On Four Medical and Surgical Procedures
Performed By Institutions With Open-Heart Surgery Facilities

	ALL INSTITUTIONS (N = 523)					ONLY THOSE INSTITUTIONS PERFORMING ONE OR MORE PROCEDURES				
PROCEDURE	RANGE	MEAN	S.D.	MEDIAN	N	RANGE	MEAN	S.D.	MEDIAN	N
ADULT OPEN-HEART SURGERY	0-4202	343.1	361.7	256.8	507	1-4202	357.2	362.2	269.0	487
PEDIATRIC OPEN-HEART SURGERY	0-906	28.7	75.1	.3	404	1-906	75.3	106.4	49.8	154
KIDNEY TRANSPLANTS	0-200	10.2	24.8	.2	403	1-200	39.4	35.2	27.2	104
CARDIAC CATHETERIZATIONS	0-7474	925.9	820.7	740.5	480	86-7474	931.7	820.0	750.0	477

Table 39-16
Number and Percent Distribution of Adult Open-Heart Surgical Procedures By Number of Institutions

NUMBER OF PROCEDURES	ALL INSTITUTIONS (N=507)		THOSE INSTITUTIONS PERFORMING ONE OR MORE (N=487)	
	NUMBER	PERCENT	NUMBER	PERCENT
0	20	3.9	--	--
1 - 25	7	1.4	7	1.4
26 - 50	13	2.6	13	2.7
51 - 75	18	3.5	18	3.7
76 - 100	20	3.9	20	4.1
101 - 125	32	6.3	32	6.6
126 - 150	32	6.3	32	6.6
151 - 175	26	5.1	26	5.3
176 - 200	30	5.9	30	6.2
201 - 225	25	4.9	25	5.1
226 - 250	28	5.5	28	5.7
251 - 275	21	4.1	21	4.3
276 - 300	23	4.5	23	4.7
301 - 400	79	15.6	79	16.2
401 - 500	42	8.3	42	8.6
501 - 600	26	5.1	26	5.3
601 - 700	11	2.2	11	2.3
701 - 800	9	1.8	9	1.8
801 - 900	14	2.8	14	2.9
901 - 1000	11	2.2	11	2.3
1001+	20	3.9	20	4.1

Table 39-17
Number and Percent Distribution of Pediatric Open-Heart Surgical Procedures By Number of Institutions

NUMBER OF PROCEDURES	ALL INSTITUTIONS (N=404)		THOSE INSTITUTIONS PERFORMING ONE OR MORE (N=154)	
	NUMBER	PERCENT	NUMBER	PERCENT
0	250	61.9	--	--
1 - 25	57	14.1	57	37.0
26 - 50	25	6.2	25	16.2
51 - 75	25	6.2	25	16.2
76 - 100	13	3.2	13	8.4
101 - 125	8	2.0	8	5.2
126 - 150	9	2.2	9	5.8
151 - 175	5	1.2	5	3.2
176 - 200	1	0.2	1	0.6
201 - 225	1	0.2	1	0.6
226 - 250	1	0.2	1	0.6
251 - 300	3	0.6	3	1.9
300+	6	1.1	6	3.9

percent indicated that they had not performed any of these procedures in 1982. The average number of procedures performed at those institutions that did one or more pediatric cases was 75.3 (S.D. = 106.4), although the range was between 1 and 906. The median number of pediatric cases was 49.8. Table 39-17 provides more detailed data on the total volume of pediatric open-heart surgery at those institutions that performed one or more of these procedures.

In the U.S. in 1982, there were 156 Medicare-approved renal transplant centers. Of the 523 institutions that participated in our survey of open-heart surgery facilities, 403 provided valid data on the number of kidney transplants they performed, of which, 104 or 25.8 percent performed one or more renal transplants in 1982. The average number of procedures performed at those institutions that did one or more kidney transplants was 39.4 (S.D. = 35.2), although the range was between 1 and 200. The median number of kidney transplants was 27.2. Table 39-18 provides more detailed data on the total volume of kidney transplant activity at those institutions that performed one or more kidney transplants.

The last procedure we obtained data on was cardiac catheterizations. As shown in Table 39-19, of the 480 institutions providing valid data, three or 0.6 percent did not perform any cardiac catheterizations in 1982. The average number of "caths" performed at those institutions that did one or more was 931.7 (S.D. = 820.0), although the range was between 86 and 7,474. The median number of cardiac catheterizations was 750.0. Table 39-19 provides more

Table 39-18
Number and Percent Distribution of Kidney Transplants
By Number of Institutions

NUMBER OF PROCEDURES	ALL INSTITUTIONS (N=403)		THOSE INSTITUTIONS PERFORMING ONE OR MORE (N=104)	
	NUMBER	PERCENT	NUMBER	PERCENT
0	299	74.2	--	--
1 - 25	50	12.4	50	48.1
26 - 50	24	6.0	24	23.1
51 - 75	19	4.7	19	18.3
76 - 100	6	1.5	6	5.8
101 - 125	1	0.2	1	1.0
126 - 150	1	0.2	1	1.0
151 - 175	2	0.5	2	1.9
176 - 200	1	0.2	1	1.0
201 - 225	0	0.0	0	0.0

Table 39-19
Number and Percent Distribution of Cardiac Catheterizations
By Number of Institutions

NUMBER OF PROCEDURES	ALL INSTITUTIONS (N=480)		THOSE INSTITUTIONS PERFORMING ONE OR MORE (N=477)	
	NUMBER	PERCENT	NUMBER	PERCENT
0	3	0.6	--	--
1 - 100	1	0.2	1	0.2
101 - 200	22	4.6	22	4.6
201 - 300	31	6.5	31	6.5
301 - 400	42	8.8	42	8.8
401 - 500	48	10.0	48	10.1
501 - 1000	187	39.0	187	39.2
1001 - 2000	114	23.8	114	23.9
2001 - 3000	21	4.4	21	4.4
3001 - 4000	4	0.8	4	0.8
4001 - 5000	5	1.0	5	1.0
5001 - 6000	0	0.0	0	0.0
6001 - 7000	0	0.0	0	0.0
7001 - 8000	2	0.4	2	0.4

detailed data on the volume of cardiac catheterization activity at those hospitals that performed one or more of these procedures.

Unfortunately not all the institutions that participated in the survey were able to provide data on the total volume of medical and surgical procedures that they performed. Approximately 20 percent failed to report the number of pediatric surgical procedures and number of kidney transplants that they performed (see Table 39-20). It is quite possible, however, that those institutions that failed to provide these data did not perform either pediatric open-heart surgery, or kidney transplants. For example, as noted above, there were 156 Medicare-approved renal transplant programs in the U.S. in 1982. In this survey, 104 institutions reported that they performed one or more renal transplants.

Data were also obtained from each of the participating institutions on the number of full-time equivalent (FTE) staff members they had for a variety of medical specialties thought to be important in the successful operation of a transplant program. As shown in Table 39-21, not all institutions had staff members from each of the assorted medical specialties. Of the institutions that responded to the survey, 246 had no virologists, 374 had no transplant surgeons, 157 had no immunologists, and 41 had no infectious disease specialists. Quite surprisingly, no medical specialty was represented at all the institutions. Also, as shown in Table 39-21, many institutions failed to report the FTEs for many of the medical specialties. For example, 169 institutions did not know whether there were virologists on their staff (see Table 39-22).

Table 39-20
Missing Data Profile for Medical and Surgical Procedures

PROCEDURE	MISSING DATA	
	NUMBER OF INSTITUTIONS	PERCENT OF INSTITUTIONS
Adult Open-Heart Surgery	16	3.1
Pediatric Open-Heart Surgery	119	22.8
Kidney Transplants	120	22.9
Cardiac Catheterizations	43	8.2

Table 39-21
Descriptive Statistics On The Distribution of Medical Specialties
At Institutions With Open-Heart Surgery Facilities

	ALL INSTITUTIONS					INSTITUTIONS WITH >0 SPECIALISTS				
MEDICAL SPECIALTY	RANGE	MEAN	S.D.	MEDIAN	N	RANGE	MEAN	S.D.	MEDIAN	N
ANESTHESIOLOGISTS	0-145	13.0	12.5	10.00	489	0.5-145	13.2	12.5	10.0	482
CARDIOLOGISTS	0-84	11.5	10.0	8.00	487	1.0-84	11.7	9.9	9.0	478
CARDIOVASCULAR SURGEONS	0-29	5.4	4.7	4.00	482	0.5-29	5.5	4.6	4.0	467
IMMUNOLOGISTS	0-32	1.2	2.8	1.00	399	0.5-32	2.7	3.1	2.0	242
INFECTIOUS DISEASE SPECIALISTS	0-15	2.6	2.5	2.00	452	0.5-15	2.9	2.4	2.0	411
NEUROLOGISTS	0-62	6.5	6.9	5.00	467	0.3-62	6.8	6.9	5.0	450
NEUROSURGEONS	0-34	4.6	4.1	3.00	469	0.1-34	4.8	4.1	4.0	447
PATHOLOGISTS	0-60	7.4	7.0	5.00	481	1.0-60	7.5	6.9	5.0	474
TRANSPLANT SURGEONS	0-10	1.0	1.8	0.03	387	0.7-10	2.6	2.0	2.0	150
VIROLOGISTS	0-7	.5	1.1	0.04	354	0.5-2	1.7	1.4	1.0	108

Table 39-22
Missing Data Profile for Medical Specialties

MEDICAL SPECIALTY	MISSING DATA: NUMBER OF INSTITUTIONS	MISSING DATA: PERCENT OF INSTITUTIONS
Anesthesiologists	34	6.5
Cardiologists	36	6.9
Cardiovascular Surgeons	41	7.8
Immunologists	124	23.7
Infectious Disease Specialists	71	13.6
Neurologists	56	10.7
Neurosurgeons	54	10.3
Pathologists	42	8.0
Transplant Surgeons	136	26.0
Virologists	169	32.3

Each hospital was also asked to indicate whether or not they had their own organ procurement program. None of the institutions indicated that they did not know. Of those that knew, 139 or 27.0 percent said that they did have a program.

All institutions were queried about their hospital decision-making process. Table 39-23 shows which groups or persons are required to give their consent when a major policy decision such as initiating a heart transplant program is at issue. Although such a decision is likely to be made jointly by two or more individuals or groups, it is clear that hospital administrators and the departments of surgery must provide their consent. Nonetheless, there are others who must also be involved in this process, as shown in Table 39-23.

2. RESPONSES TO SPECIFIC QUESTIONS CONCERNING HEART TRANSPLANTATION

Institutions responding to our survey can be grouped into seven categories, not all of which are necessarily mutually exclusive. They are: (1) those institutions that have active heart transplant programs, that is, they performed one or more heart transplants in 1983 or 1984 (N = 12), (2) those institutions that have inactive heart transplant programs, that is, institutions that have performed a heart transplant in the past but are not doing them now (N = 12), (3) those institutions that are currently considering a heart transplant program (N = 74), (4) those institutions that are not currently considering a heart transplant program (N = 418), (5) those institutions that indicated they will begin to perform heart transplants within the next five years (N = 91), (6) those institutions that said if Medicare were to cover heart transplantation they would be "certain" to initiate a

Table 39-23
Persons Or Groups That Must Approve Major Policy Decisions

PERSON OR GROUP	NUMBER INDICATING YES	PERCENT INDICATING YES
Department of Surgery	466	89.1
Chief of Medical Staff	363	69.4
Hospital Administration	489	93.5
Board of Trustees	424	81.1
Other	196	37.5
Other	69	13.2

program, (N = 19); and (7) those institutions that indicated that Medicare coverage of heart transplantation would "increase the likelihood" that they would start a heart transplant program (N = 151). Hereafter we will present the results of our survey according to each of these groups. We will refer to them as Group 1, Group 2, Group 3, and so forth. Again, however, it should be emphasized that only institutions in Group 1, Group 2, Group 3, and Group 4 are mutually exclusive (N = 516). Groups 5 through 7 are not mutually exclusive. We now begin with a discussion of Group 1 results.

a. Group 1. Active Heart Transplant Programs. First it should be noted that not all institutions that had active heart transplant programs in 1983 participated in our survey. At the time of the survey we estimate there were 17 active heart transplant programs in the U.S., 12 of these responded to our survey.

Descriptive data on volume of medical and surgical procedures, distribution of staff according to selected medical specialties, and the extent of missing data are summarized in Tables 39-24 through 39-31.

All active programs were asked to indicate the total number of heart transplants they performed. Table 39-32 shows the distribution of procedures across institutions. Each institution was also asked to indicate the year in which they performed their first heart transplant. Of the active programs, 4 did their first procedure in 1968. One each performed their first heart transplant in 1972, 1977, 1979, 1980, 1982, and 1983. Two institutions performed their first heart transplant in 1984. Of these 12 institutions, 10 had performed

Table 39-24
Descriptive Statistics On Four Medical and Surgical Procedures
Performed By Active Heart Transplant Centers

	ALL INSTITUTIONS (N = 12)				
PROCEDURE	RANGE	MEAN	S.D.	MEDIAN	N
Adult Open-Heart Surgery	201-4202	1008.5	1112.1	509	12
Pediatric Open-Heart Surgery	0-490	116.8	46.6	57	11
Kidney Transplants	0-128	47.5	43.3	34	11
Cardiac Catheterizations	352-7474	1555.9	1939.1	951.5	12

Table 39-25
Number and Percent Distribution of Adult Open-Heart Surgical Procedures By Active Heart Transplant Centers

NUMBER OF PROCEDURES	ALL INSTITUTIONS (N=12) NUMBER	PERCENT
0	0	0.0
1 - 25	0	0.0
26 - 50	0	0.0
51 - 75	0	0.0
76 - 100	0	0.0
101 - 125	0	0.0
126 - 150	0	0.0
151 - 175	0	0.0
176 - 200	0	0.0
201 - 225	1	8.3
226 - 250	1	8.3
251 - 275	0	0.0
276 - 300	0	0.0
301 - 400	2	16.7
401 - 500	2	16.7
501 - 600	0	0.0
601 - 700	0	0.0
701 - 800	0	0.6
801 - 900	1	8.3
901 - 1000	1	8.3
1001+	4	33.3

Table 39-26
Number and Percent Distribution of Pediatric Open-Heart Surgical Procedures By Active Heart Transplant Centers

NUMBER OF PROCEDURES	ALL INSTITUTIONS (N=12) NUMBER	PERCENT
0	3	25.0
1 - 25	0	0.0
26 - 50	2	16.7
51 - 75	1	8.3
76 - 100	2	16.7
101 - 125	0	0.0
126 - 150	0	0.0
151 - 175	1	8.3
176 - 200	0	0.0
201 - 225	0	0.0
226 - 250	0	0.0
251 - 300	0	0.0
301+	2	16.7
UNKNOWN	1	8.3

Table 39-27
Number and Percent Distribution of Kidney Transplants
By Active Heart Transplant Centers

NUMBER OF PROCEDURES	ALL INSTITUTIONS (N=12) NUMBER	PERCENT
0	2	16.7
1 - 25	3	25.0
26 - 50	2	16.7
51 - 75	0	0.0
76 - 100	2	16.7
101 - 125	1	8.3
126 - 150	1	8.3
151 - 175	0	0.0
176 - 200	0	0.0
201 - 225	0	0.0
UNKNOWN	1	8.3

Table 39-28
Number and Percent Distribution of Cardiac Catheterizations
By Active Heart Transplant Centers

NUMBER OF PROCEDURES	ALL INSTITUTIONS (N=12) NUMBER	PERCENT
0	0	0.0
1 - 100	0	0.0
101 - 200	0	0.0
201 - 300	0	0.0
301 - 400	1	8.3
401 - 500	1	8.3
501 - 1000	4	33.3
1001 - 2000	4	33.3
2001 - 3000	1	8.3
3001 - 4000	0	0.0
4001 - 5000	0	0.0
5001 - 6000	0	0.0
6001 - 7000	0	0.0
7001 - 8000	1	8.3

Table 39-29
Missing Data Profile For Medical and Surgical Procedures--
Active Heart Transplant Centers

PROCEDURE	MISSING DATA	
	NUMBER OF INSTITUTIONS	PERCENT OF ALL INSTITUTIONS
Adult Open-Heart Surgery	0	0.0
Pediatric Open-Heart Surgery	1	8.3
Kidney Transplants	1	8.3
Cardiac Catheterizations	0	0.0

Table 39-30
Descriptive Statistics On The Distribution of Medical Specialties
At Active Heart Transplant Centers

	ALL INSTITUTIONS (N = 12)				
MEDICAL SPECIALTY	RANGE	MEAN	S.D.	MEDIAN	N
Anesthesiologists	2-58	27.5	18.6	26.0	12
Cardiologists	7-84	24.8	20.3	20.5	12
Cardiovascular Surgeons	1.2-9.0	5.3	2.1	5.5	12
Immunologists	1.0-10.0	4.1	3.4	2.5	10
Infectious Disease Specialists	1-15	6.4	4.9	5.3	11
Neurologists	4-48	19.3	14.2	15.8	11
Neurosurgeons	1.5-34.0	8.7	9.3	4.3	12
Pathologists	7-33	20.5	8.3	18.0	11
Transplant Surgeons	1-10	4.3	2.7	3.5	12
Virologists	0-6	2.3	2.4	1.2	8

Table 39-31
Missing Data Profile For Medical Specialties--
Active Heart Transplant Programs

SPECIALTY	MISSING DATA: NUMBER OF INSTITUTIONS	MISSING DATA: PERCENT OF ALL INSTITUTIONS
Anesthesiologists	0	0.0
Cardiologists	0	0.0
Cardiovascular Surgeons	0	0.0
Immunologists	2	16.7
Infectious Disease Specialists	1	8.3
Neurologists	1	8.3
Neurosurgeons	0	0.0
Pathologists	1	8.3
Transplant Surgeons	0	0.0
Virologists	4	33.3

Table 39-32
Number of Heart Transplants Performed By
Active Heart Transplant Programs

TOTAL NUMBER OF PROCEDURES	NUMBER OF INSTITUTIONS	PERCENT OF INSTITUTIONS
1	3	25.0
7	1	8.3
18	2	16.7
25	1	8.3
37	1	8.3
40	1	8.3
43	1	8.3
73	1	8.3
314	1	8.3

their most recent heart transplant in 1984 and two in 1983. Two of the active heart transplant programs indicated that their programs were being conducted on a trial basis.

We also inquired as to how many heart transplants the active programs had performed in the past year. The results are summarized in Table 39-33. Clearly, in terms of total volume, two programs are large. With regard to volume of heart transplant activity, we were especially interested in whether programs would expand if heart transplants were covered by the Medicare program and how many heart transplants per year would be considered optimal. In response to the first question, 10 programs said they would expand, one indicated it did not know, and one said it would not. There was wide variation in the responses to the optimal number of transplants. The responses are summarized in Table 39-34. The average number of transplants considered optimal was 20.6 (206/10).

Tables 39-35 through 39-43 provide listings by region of the country as to the ranking of the various active heart transplant programs according to the criteria specified in Tables 39-6 through 39-13, above. All the active programs fall in Class I. Nine are Class I, Level A, two are Class I, Level B, and one is Class I, Level D. Table 39-44 summarizes the results presented in Tables 39-35 through 39-43.

b. Group 2. Inactive Heart Transplant Programs. Unfortunately, due to a faulty skip pattern in our questionnaire, we failed to obtain all the data we would have liked on inactive heart transplant programs. For example, these programs were not asked if

Table 39-33
Number of Heart Transplants Performed In The Past Year
By Active Heart Transplant Centers

TOTAL NUMBER OF PROCEDURES	NUMBER OF INSTITUTIONS	PERCENT OF INSTITUTIONS
0	1	8.3
1	2	16.7
5	1	8.3
7	1	8.3
10	1	8.3
12	1	8.3
16	2	16.7
18	1	8.3
28	1	8.3
37	1	8.3

Table 39-34
Optimal Number of Heart Transplants Per Year Reported
By Active Heart Transplant Centers

TOTAL NUMBER OF PROCEDURES	NUMBER OF INSTITUTIONS	PERCENT OF INSTITUTIONS
5	1	8.3
8	1	8.3
12	1	8.3
15	1	8.3
17	1	8.3
20	1	8.3
24	2	16.7
36	1	8.3
45	1	8.3
UNKNOWN	2	16.7

Table 39-35
Ranking of Active Heart Transplant Centers: Class I

CLASS BY REGION	LEVEL				
CLASS I	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	1	0	0	0	1
Mid Atlantic	2	0	0	0	2
South Atlantic	0	1	0	1	2
East North Central	0	0	0	0	0
East South Central	1	0	0	0	1
West North Central	1	0	0	0	1
West South Central	1	0	0	0	1
Mountain	0	1	0	0	1
Pacific	3	0	0	0	3
TOTAL	9	2	0	1	12

Table 39-36
Ranking of Active Heart Transplant Centers: Class II

CLASS BY REGION	LEVEL				
CLASS II	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	0	0	0	0	0
South Atlantic	0	0	0	0	0
East North Central	0	0	0	0	0
East South Central	0	0	0	0	0
West North Central	0	0	0	0	0
West South Central	0	0	0	0	0
Mountain	0	0	0	0	0
Pacific	0	0	0	0	0
TOTAL	0	0	0	0	0

Table 39-37
Ranking of Active Heart Transplant Centers: Class III

CLASS BY REGION	LEVEL				
CLASS III	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	0	0	0	0	0
South Atlantic	0	0	0	0	0
East North Central	0	0	0	0	0
East South Central	0	0	0	0	0
West North Central	0	0	0	0	0
West South Central	0	0	0	0	0
Mountain	0	0	0	0	0
Pacific	0	0	0	0	0
TOTAL	0	0	0	0	0

Table 39-38
Ranking of Active Heart Transplant Centers: Class IV

CLASS BY REGION	LEVEL				
CLASS IV	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	0	0	0	0	0
South Atlantic	0	0	0	0	0
East North Central	0	0	0	0	0
East South Central	0	0	0	0	0
West North Central	0	0	0	0	0
West South Central	0	0	0	0	0
Mountain	0	0	0	0	0
Pacific	0	0	0	0	0
TOTAL	0	0	0	0	0

Table 39-39
Ranking of Active Heart Transplant Centers: Class V

CLASS BY REGION	LEVEL				
CLASS V	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	0	0	0	0	0
South Atlantic	0	0	0	0	0
East North Central	0	0	0	0	0
East South Central	0	0	0	0	0
West North Central	0	0	0	0	0
West South Central	0	0	0	0	0
Mountain	0	0	0	0	0
Pacific	0	0	0	0	0
TOTAL	0	0	0	0	0

Table 39-40
Ranking of Active Heart Transplant Centers: Class VI

CLASS BY REGION	LEVEL				
CLASS VI	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	0	0	0	0	0
South Atlantic	0	0	0	0	0
East North Central	0	0	0	0	0
East South Central	0	0	0	0	0
West North Central	0	0	0	0	0
West South Central	0	0	0	0	0
Mountain	0	0	0	0	0
Pacific	0	0	0	0	0
TOTAL	0	0	0	0	0

Table 39-41
Ranking of Active Heart Transplant Centers: Class VII

CLASS BY REGION	LEVEL				
CLASS VII	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	0	0	0	0	0
South Atlantic	0	0	0	0	0
East North Central	0	0	0	0	0
East South Central	0	0	0	0	0
West North Central	0	0	0	0	0
West South Central	0	0	0	0	0
Mountain	0	0	0	0	0
Pacific	0	0	0	0	0
TOTAL	0	0	0	0	0

Table 39-42
Ranking of Active Heart Transplant Centers: Class VIII

CLASS BY REGION	LEVEL				
CLASS VIII	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	0	0	0	0	0
South Atlantic	0	0	0	0	0
East North Central	0	0	0	0	0
East South Central	0	0	0	0	0
West North Central	0	0	0	0	0
West South Central	0	0	0	0	0
Mountain	0	0	0	0	0
Pacific	0	0	0	0	0
TOTAL	0	0	0	0	0

Table 39-43
Ranking of Active Heart Transplant Centers: Class 0

CLASS BY REGION	LEVEL UNSPECIFIED
CLASS 0	
Puerto Rico	0
New England	0
Mid Atlantic	0
South Atlantic	0
East North Central	3
East South Central	0
West North Central	0
West South Central	1
Mountain	2
Pacific	2
TOTAL	8

Table 39-44
Region By Class Classification For
Active Heart Transplant Centers

	CLASS									
REGION	I	II	III	IV	V	VI	VII	VIII	O	TOTAL
Puerto Rico	0	0	0	0	0	0	0	0	0	0
New England	1	0	0	0	0	0	0	0	0	1
Mid Atlantic	2	0	0	0	0	0	0	0	0	2
South Atlantic	2	0	0	0	0	0	0	0	0	2
East North Central	0	0	0	0	0	0	0	0	0	0
East South Central	1	0	0	0	0	0	0	0	0	1
West North Central	1	0	0	0	0	0	0	0	0	1
West South Central	1	0	0	0	0	0	0	0	0	1
Mountain	1	0	0	0	0	0	0	0	0	1
Pacific	3	0	0	0	0	0	0	0	0	3
TOTAL	12	0	0	0	0	0	0	0	0	12

they were going to start up once again. In fact, we know that one of the inactive programs has performed one heart transplant since our survey was completed. Nonetheless, some data were collected on these programs. Descriptive data on volume of medical and surgical procedures, number and distribution of staff according to selected medical specialties, and the extent of missing data on these institutions are all summarized in Tables 39-45 through 39-52.

In general, all the inactive programs had performed very few heart transplants. Of these 12 programs, only two had performed more than 10 procedures, as shown in Table 39-53. Four centers had performed only one. Most of these centers performed their first procedure in the early days: 2 in 1967, 3 in 1968, 3 in 1969, 1 in 1970, 1 in 1972, 1 in 1973, and 1 in 1979. The year of their most recent transplant shows that ten of the inactive programs have been inactive for six or more years. The distribution of centers according to year of most recent transplant is follows: 1 in 1967, 1 in 1968, 3 in 1969, 3 in 1970, 1 in 1972, 1 in 1978, 1 in 1980, and 1 in 1981.

Although we did not ask the inactive programs about starting up again, eight of the programs inadvertently answered the question concerning expansion of their program if Medicare covered heart transplants. While this question was intended only for active heart transplant programs, eight of the inactive programs said they would. Thus, we can assume that at least eight of the inactive programs are likely to start up again. Moreover, all of the inactive programs responded to the question concerning the optimal number of heart

Table 39-45
Descriptive Statistics On Four Medical and Surgical Procedures
Performed At Inactive Heart Transplant Centers

	ALL INSTITUTIONS (N = 12)				
PROCEDURE	RANGE	MEAN	S.D.	MEDIAN	N
Adult Open-Heart Surgery	0-3411	607	937.1	267.5	12
Pediatric Open-Heart Surgery	0-906	158.6	260.7	51.5	12
Kidney Transplants	0-200	49.5	70.0	17.0	11
Cardiac Catheterizations	0-1381	531.7	420.3	360.5	10

Table 39-46
Number and Percent Distribution of Adult Open-Heart Surgical Procedures At Inactive Heart Transplant Centers

NUMBER OF PROCEDURES	ALL INSTITUTIONS (N=12) NUMBER	PERCENT
0	1	8.3
1 - 25	0	0.0
26 - 50	0	0.0
51 - 75	1	8.3
76 - 100	0	0.0
101 - 125	1	8.3
126 - 150	1	8.3
151 - 175	0	0.0
176 - 200	1	8.3
201 - 225	0	0.0
226 - 250	1	8.3
251 - 275	0	0.0
276 - 300	0	0.0
301 - 400	1	8.3
401 - 500	2	16.7
501 - 600	0	0.0
601 - 700	0	0.0
701 - 800	0	0.6
801 - 900	0	0.0
901 - 1000	2	16.7
1001+	1	8.3

Table 39-47
Number and Percent Distribution of Pediatric Open-Heart Surgical Procedures By Inactive Heart Transplant Centers

NUMBER OF PROCEDURES	ALL INSTITUTIONS (N=12) NUMBER	PERCENT
0	3	25.0
1 - 25	2	16.7
26 - 50	1	8.3
51 - 75	0	0.0
76 - 100	0	0.0
101 - 125	1	8.3
126 - 150	3	25.0
151 - 175	0	0.0
176 - 200	0	0.0
201 - 225	0	0.0
226 - 250	0	0.0
251 - 300	0	0.0
301+	0	0.0
UNKNOWN	2	16.7

Table 39-48
Number and Percent Distribution of Kidney Transplants
By Inactive Heart Transplant Centers

NUMBER OF PROCEDURES	ALL INSTITUTIONS (N=12) NUMBER	PERCENT
0	3	25.0
1 - 25	3	25.0
26 - 50	2	16.7
51 - 75	1	8.3
76 - 100	0	0.0
101 - 125	0	0.0
126 - 150	0	0.0
151 - 175	1	8.3
176 - 200	1	8.3
201 - 225	0	0.0
UNKNOWN	1	8.3

Table 39-49
Number and Percent Distribution of Cardiac Catheterizations
By Inactive Heart Transplant Centers

NUMBER OF PROCEDURES	ALL INSTITUTIONS (N=12) NUMBER	PERCENT
0	1	8.3
1 - 100	0	0.0
101 - 200	1	8.3
201 - 300	2	16.7
301 - 400	1	8.3
401 - 500	0	0.0
501 - 1000	4	33.3
1001 - 2000	1	8.3
2001 - 3000	0	0.0
3001 - 4000	0	0.0
4001 - 5000	0	0.0
5001 - 6000	0	0.0
6001 - 7000	0	0.0
7001 - 8000	2	16.7

Table 39-50
Missing Data Profile For Medical and Surgical Procedures--
Inactive Heart Transplant Centers

PROCEDURE	MISSING DATA	
	NUMBER OF INSTITUTIONS	PERCENT OF ALL INSTITUTIONS
Adult Open-Heart Surgery	0	0.0
Pediatric Open-Heart Surgery	0	0.0
Kidney Transplants	1	8.3
Cardiac Catheterizations	2	16.7

Table 39-51
Descriptive Statistics On The Distribution of Medical Specialties
At Inactive Heart Transplant Centers

	ALL INSTITUTIONS (N = 12)				
MEDICAL SPECIALTY	RANGE	MEAN	S.D.	MEDIAN	N
Anesthesiologists	3.5-42.0	19.7	11.9	17.6	12
Cardiologists	3.0-25.0	14.6	7.4	15.0	11
Cardiovascular Surgeons	1.8-23.5	6.9	6.1	5.0	12
Immunologists	1.0-32.0	6.9	9.7	4.0	9
Infectious Disease Specialists	1.0-12.5	5.7	3.8	5.0	11
Neurologists	3.8-36.0	17.0	12.0	16.1	10
Neurosurgeons	1.5-32.0	6.9	8.3	4.1	12
Pathologists	4.0-48.8	18.5	13.0	16.0	11
Transplant Surgeons	0-10.0	3.5	2.8	3.0	11
Virologists	0-7.0	2.5	2.7	1.1	8

Table 39-52
Missing Data Profile For Medical Specialties--
Inactive Heart Transplant Centers

SPECIALTY	MISSING DATA: NUMBER OF INSTITUTIONS	MISSING DATA: PERCENT OF ALL INSTITUTIONS
Anesthesiologists	0	0.0
Cardiologists	1	8.3
Cardiovascular Surgeons	0	0.0
Immunologists	3	25.0
Infectious Disease Specialists	1	8.3
Neurologists	2	16.7
Neurosurgeons	0	0.0
Pathologists	1	8.3
Transplant Surgeons	1	8.3
Virologists	4	33.3

Table 39-53
Number of Heart Transplants Ever Performed By
Inactive Heart Transplant Programs

TOTAL NUMBER OF PROCEDURES	NUMBER OF INSTITUTIONS	PERCENT OF INSTITUTIONS
1	4	33.3
2	2	16.7
3	1	8.3
4	1	8.3
6	1	8.3
8	1	8.3
12	1	8.3
14	1	8.3

transplants per year. Five of the centers indicated that 0 procedures was optimal, but the other seven centers said between 5 and 27 procedures, with an average of 17.4 (122/7).

In light of their responses to our questions, all of the inactive heart transplant programs were ranked according to our class by level criteria. Tables 39-54 through 39-62 show this ranking according to region of the country. Table 39-63 summarizes these data. As shown, three of the inactive centers are Class I, one is Class V, and eight are Class 0. Again, the Class 0 centers either did not have the required resources to perform heart transplants, or failed to report the data required to make this determination.

c. Group 3. Institutions Currently Considering Heart Transplantation. In responding to our survey, 74 or 14.1 percent of the institutions indicated that they were currently considering heart transplantation. These institutions were asked several questions about their plans for the future. Of these institutions, 63 or 85.1 percent predicted that they would begin to perform heart transplants within the next five years. Seven institutions said they would not and 4 said they did not know.

When asked how Medicare funding might affect their plans, 14 or 18.9 percent of these institutions said that they would certainly begin to perform heart transplants, 41 or 55.4 percent said it would increase the likelihood, and 19 or 25.7 percent said a Medicare decision in favor of heart transplantation would not affect their plans.

Table 39-54
Ranking of Inactive Heart Transplant Centers: Class I

CLASS BY REGION	LEVEL				
CLASS I	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	0	0	0	0	0
South Atlantic	0	0	0	0	0
East North Central	2	0	0	0	2
East South Central	0	0	0	0	0
West North Central	0	0	0	0	0
West South Central	0	0	0	0	0
Mountain	0	0	0	0	0
Pacific	1	0	0	0	1
TOTAL	3	0	0	0	3

Table 39-55
Ranking of Inactive Heart Transplant Centers: Class II

CLASS BY REGION	LEVEL				
CLASS II	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	0	0	0	0	0
South Atlantic	0	0	0	0	0
East North Central	0	0	0	0	0
East South Central	0	0	0	0	0
West North Central	0	0	0	0	0
West South Central	0	0	0	0	0
Mountain	0	0	0	0	0
Pacific	0	0	0	0	0
TOTAL	0	0	0	0	0

Table 39-56
Ranking of Inactive Heart Transplant Centers: Class III

CLASS BY REGION	LEVEL				
CLASS III	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	0	0	0	0	0
South Atlantic	0	0	0	0	0
East North Central	0	0	0	0	0
East South Central	0	0	0	0	0
West North Central	0	0	0	0	0
West South Central	0	0	0	0	0
Mountain	0	0	0	0	0
Pacific	0	0	0	0	0
TOTAL	0	0	0	0	0

Table 39-57
Ranking of Inactive Heart Transplant Centers: Class IV

CLASS BY REGION	LEVEL				
CLASS IV	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	0	0	0	0	0
South Atlantic	0	0	0	0	0
East North Central	0	0	0	0	0
East South Central	0	0	0	0	0
West North Central	0	0	0	0	0
West South Central	0	0	0	0	0
Mountain	0	0	0	0	0
Pacific	0	0	0	0	0
TOTAL	0	0	0	0	0

Table 39-58
Ranking of Inactive Heart Transplant Centers: Class V

CLASS BY REGION	LEVEL				
CLASS V	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	1	0	0	0	1
South Atlantic	0	0	0	0	0
East North Central	0	0	0	0	0
East South Central	0	0	0	0	0
West North Central	0	0	0	0	0
West South Central	0	0	0	0	0
Mountain	0	0	0	0	0
Pacific	0	0	0	0	0
TOTAL	1	0	0	0	1

Table 39-59
Ranking of Active Heart Transplant Centers: Class VI

CLASS BY REGION	LEVEL				
CLASS VI	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	0	0	0	0	0
South Atlantic	0	0	0	0	0
East North Central	0	0	0	0	0
East South Central	0	0	0	0	0
West North Central	0	0	0	0	0
West South Central	0	0	0	0	0
Mountain	0	0	0	0	0
Pacific	0	0	0	0	0
TOTAL	0	0	0	0	0

Table 39-60
Ranking of Active Heart Transplant Centers: Class VII

CLASS BY REGION	LEVEL				
CLASS VII	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	0	0	0	0	0
South Atlantic	0	0	0	0	0
East North Central	0	0	0	0	0
East South Central	0	0	0	0	0
West North Central	0	0	0	0	0
West South Central	0	0	0	0	0
Mountain	0	0	0	0	0
Pacific	0	0	0	0	0
TOTAL	0	0	0	0	0

Table 39-61
Ranking of Active Heart Transplant Centers: Class VIII

CLASS BY REGION	LEVEL				
CLASS VIII	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	0	0	0	0	0
South Atlantic	0	0	0	0	0
East North Central	0	0	0	0	0
East South Central	0	0	0	0	0
West North Central	0	0	0	0	0
West South Central	0	0	0	0	0
Mountain	0	0	0	0	0
Pacific	0	0	0	0	0
TOTAL	0	0	0	0	0

Table 39-62
Ranking of Inactive Heart Transplant Centers: Class O

CLASS BY REGION	LEVEL UNSPECIFIED
CLASS O	
Puerto Rico	0
New England	0
Mid Atlantic	0
South Atlantic	0
East North Central	3
East South Central	0
West North Central	0
West South Central	1
Mountain	2
Pacific	2
TOTAL	8

Table 39-63
Region By Class Classification For
Inactive Heart Transplant Centers

REGION	CLASS I	II	III	IV	V	VI	VII	VIII	O	TOTAL
Puerto Rico	0	0	0	0	0	0	0	0	0	0
New England	0	0	0	0	0	0	0	0	0	0
Mid Atlantic	0	0	0	0	1	0	0	0	0	1
South Atlantic	0	0	0	0	0	0	0	0	0	0
East North Central	2	0	0	0	0	0	0	0	3	5
East South Central	0	0	0	0	0	0	0	0	0	0
West North Central	0	0	0	0	0	0	0	0	0	0
West South Central	0	0	0	0	0	0	0	0	1	1
Mountain	0	0	0	0	0	0	0	0	2	2
Pacific	1	0	0	0	0	0	0	0	2	3
TOTAL	3	0	0	0	1	0	0	0	8	12

Of these 74 institutions, exactly one-half (37) indicated that a surgeon on their staff had performed or assisted with a heart transplant in the past. Thus, it is not surprising that many of the institutions currently considering heart transplantation are doing so. To provide additional insight into the qualifications of these instutitions, we have provided descriptive data on the volume of selected medical and surgical procedures, number and distribution of selected medical specialties, and the extent of missing data on these instutitions in Tables 39-64 through 39-71. Also, once again, we have ranked these instutitions according to the class and level criteria we have previously specified. Tables 39-72 through 39-80 show these rankings according to region of the country. As shown here, of the 74 institutions currently considering heart transplantation, 44.6 percent are Class I, Level A. Thirty-nine or 52.7 percent fall within Class I. Table 39-81 summarizes the overall results. Eight institutions are Class III, 6 are Class V, 1 is Class VI, 3 are Class VIII, and 17 are Class O. Unfortunately, many of these institutions fall in Class O indicating that they do not have the resources necessary to perform heart transplants or they failed to report the data we needed to classify them.

d. Group 4. Institutions Not Currently Considering Heart Transplantation. The majority (N = 418) of the institutions that responded to our survey indicated that they were not currently considering heart transplantation. Of these institutions, only 15 or 3.6 percent indicated that at some time in the past they had considered heart transplantation, although 46 or 11.0 percent say that

Table 39-64
Descriptive Statistics On Four Medical and Surgical Procedures
Performed At Institutions Currently Considering
Heart Transplantation

	ALL INSTITUTIONS (N = 74)				
PROCEDURE	RANGE	MEAN	S.D.	MEDIAN	N
Adult Open-Heart Surgery	0-1657	449	355.1	351.0	73
Pediatric Open-Heart Surgery	0-308	57.1	72.5	29.0	61
Kidney Transplants	0-159	29.0	33.0	16.8	64
Cardiac Catheterizations	118-4903	1094.0	781.9	979.5	70

Table 39-65
Number and Percent Distribution of Adult Open-Heart Surgical Procedures At Institutions Currently Considering Heart Transplantation

NUMBER OF PROCEDURES	ALL INSTITUTIONS (N=74) NUMBER	PERCENT
0	5	6.8
1 - 25	0	0.0
26 - 50	3	4.1
51 - 75	1	4.1
76 - 100	1	1.4
101 - 125	2	2.7
126 - 150	1	1.4
151 - 175	4	5.4
176 - 200	6	8.1
201 - 225	5	6.8
226 - 250	3	4.1
251 - 275	1	1.4
276 - 300	0	0.0
301 - 400	7	9.5
401 - 500	8	10.8
501 - 600	7	9.5
601 - 700	2	2.7
701 - 800	3	4.1
801 - 900	3	4.1
901 - 1000	6	8.1
1001+	5	6.8
UNKNOWN	1	1.4

Table 39-66
Number and Percent Distribution of Pediatric Open-Heart Surgical Procedures At Institutions Currently Considering Heart Transplantation

NUMBER OF PROCEDURES	ALL INSTITUTIONS (N=74) NUMBER	PERCENT
0	22	29.7
1 - 25	8	10.8
26 - 50	5	6.8
51 - 75	8	10.8
76 - 100	6	8.1
101 - 125	3	4.1
126 - 150	3	4.1
151 - 175	3	4.1
176 - 200	0	0.0
201 - 225	0	0.0
226 - 250	1	1.4
251 - 300	1	1.4
301+	1	1.4
UNKNOWN	13	17.6

Table 39-67
Number and Percent Distribution of Kidney Transplants
At Institutions Currently Considering
Heart Transplantation

NUMBER OF PROCEDURES	ALL INSTITUTIONS (N=74) NUMBER	PERCENT
0	20	27.0
1 - 25	18	24.3
26 - 50	11	14.9
51 - 75	10	13.5
76 - 100	4	5.4
101 - 125	0	0.0
126 - 150	0	0.0
151 - 175	1	1.4
176 - 200	0	0.0
201 - 225	0	0.0
UNKNOWN	10	13.5

Table 39-68
Number and Percent Distribution of Cardiac Catheterizations
At Institutions Currently Considering
Heart Transplantation

NUMBER OF PROCEDURES	ALL INSTITUTIONS (N=74) NUMBER	PERCENT
0	0	0.0
1 - 100	0	0.0
101 - 200	2	2.7
201 - 300	5	6.8
301 - 400	2	2.7
401 - 500	3	4.1
501 - 1000	25	33.8
1001 - 2000	26	35.1
2001 - 3000	5	6.8
3001 - 4000	1	1.4
4001 - 5000	1	1.4
5001 - 6000	0	0.0
6001 - 7000	0	0.0
7001 - 8000	0	0.0
UNKNOWN	4	5.4

Table 39-69
Missing Data Profile For Medical and Surgical Procedures--
Institutions Currently Considering
Heart Transplantation

PROCEDURE	MISSING DATA	
	NUMBER OF INSTITUTIONS	PERCENT OF ALL INSTITUTIONS
Adult Open-Heart Surgery	1	1.4
Pediatric Open-Heart Surgery	13	17.6
Kidney Transplants	10	13.5
Cardiac Catheterizations	4	5.4

Table 39-70
Descriptive Statistics On The Distribution of Medical Specialties
At Institutions Currently Considering
Heart Transplantation

	ALL INSTITUTIONS (N = 74)				
MEDICAL SPECIALTY	RANGE	MEAN	S.D.	MEDIAN	N
Anesthesiologists	0-145	18.0	21.8	12.0	73
Cardiologists	0-75	13.3	12.8	9.0	72
Cardiovascular Surgeons	0-29	5.3	4.9	4.0	72
Immunologists	0-21	2.6	3.0	2.0	65
Infectious Disease Specialists	0-13	3.9	2.7	3.0	72
Neurologists	0-41	8.4	7.5	6.0	72
Neurosurgeons	0-21	4.9	4.1	4.0	72
Pathologists	0-60	11.6	10.7	7.0	72
Transplant Surgeons	0-6	1.9	1.6	2.0	65
Virologists	0-5	1.0	1.1	.9	51

Table 39-71
Missing Data Profile For Medical and Surgical Specialties--
Institutions Currently Considering
Heart Transplantation

	MISSING DATA	
SPECIALTY	NUMBER OF INSTITUTIONS	PERCENT OF ALL INSTITUTIONS
Anesthesiologists	1	1.4
Cardiologists	2	2.7
Cardiovascular Surgeons	2	2.7
Immunologists	9	12.2
Infectious Disease Specialists	2	2.7
Neurologists	2	2.7
Neurosurgeons	2	2.7
Pathologists	2	2.7
Transplant Surgeons	9	12.2
Virologists	23	31.1

Table 39-72
Ranking of Institutions Currently Considering Heart Transplantation:
Class I

CLASS BY REGION	LEVEL				
CLASS I	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	5	0	0	0	5
Mid Atlantic	2	1	0	0	3
South Atlantic	4	0	1	0	5
East North Central	11	0	1	0	12
East South Central	3	0	0	0	3
West North Central	2	0	0	0	2
West South Central	1	0	1	0	2
Mountain	1	0	0	0	1
Pacific	4	1	1	0	6
TOTAL	33	2	4	0	39

Table 39-73
Ranking of Institutions Currently Considering Heart Transplantation:
Class II

CLASS BY REGION	LEVEL				
CLASS II	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	0	0	0	0	0
South Atlantic	0	0	0	0	0
East North Central	0	0	0	0	0
East South Central	0	0	0	0	0
West North Central	0	0	0	0	0
West South Central	0	0	0	0	0
Mountain	0	0	0	0	0
Pacific	0	0	0	0	0
TOTAL	0	0	0	0	0

Table 39-74
Ranking of Institutions Currently Considering Heart Transplantation:
Class III

CLASS BY REGION	LEVEL				
CLASS III	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	1	0	0	0	1
Mid Atlantic	2	0	1	0	3
South Atlantic	0	0	0	0	0
East North Central	1	0	1	0	2
East South Central	0	0	0	0	0
West North Central	0	0	0	0	0
West South Central	0	0	0	0	0
Mountain	0	0	0	0	0
Pacific	2	0	0	0	2
TOTAL	6	0	2	0	8

Table 39-75
Ranking of Institutions Currently Considering Heart Transplantation:
Class IV

CLASS BY REGION	LEVEL				
CLASS IV	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	0	0	0	0	0
South Atlantic	0	0	0	0	0
East North Central	0	0	0	0	0
East South Central	0	0	0	0	0
West North Central	0	0	0	0	0
West South Central	0	0	0	0	0
Mountain	0	0	0	0	0
Pacific	0	0	0	0	0
TOTAL	0	0	0	0	0

Table 39-76
Ranking of Institutions Currently Considering Heart Transplantation:
Class V

CLASS BY REGION	LEVEL				
CLASS V	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	1	0	0	0	1
South Atlantic	0	0	0	0	0
East North Central	1	0	0	0	1
East South Central	0	0	1	0	1
West North Central	0	0	1	0	1
West South Central	0	0	1	0	1
Mountain	0	0	0	0	0
Pacific	1	0	0	0	1
TOTAL	3	0	3	0	6

Table 39-77
Ranking of Institutions Currently Considering Heart Transplantation:
Class VI

CLASS BY REGION	LEVEL				
CLASS VI	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	0	0	0	0	0
South Atlantic	0	0	0	0	0
East North Central	0	0	1	0	1
East South Central	0	0	0	0	0
West North Central	0	0	0	0	0
West South Central	0	0	0	0	0
Mountain	0	0	0	0	0
Pacific	0	0	0	0	0
TOTAL	0	0	1	0	1

Table 39-78
Ranking of Institutions Currently Considering Heart Transplantation:
Class VII

CLASS BY REGION	LEVEL				
CLASS VII	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	0	0	0	0	0
South Atlantic	0	0	0	0	0
East North Central	0	0	1	0	1
East South Central	0	0	0	0	0
West North Central	0	0	1	0	1
West South Central	0	0	0	0	0
Mountain	0	0	0	0	0
Pacific	1	0	0	0	1
TOTAL	1	0	2	0	3

Table 39-79
Ranking of Institutions Currently Considering Heart Transplantation:
Class VIII

CLASS BY REGION	LEVEL				
CLASS VIII	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	0	0	0	0	0
South Atlantic	0	0	0	0	0
East North Central	0	0	0	0	0
East South Central	0	0	0	0	0
West North Central	0	0	0	0	0
West South Central	0	0	0	0	0
Mountain	0	0	0	0	0
Pacific	0	0	0	0	0
TOTAL	0	0	0	0	0

Table 39-80
Ranking of Institutions Currently Considering Heart Transplantation:
Class O

CLASS BY REGION	LEVEL UNSPECIFIED
CLASS O	
Puerto Rico	1
New England	0
Mid Atlantic	5
South Atlantic	0
East North Central	1
East South Central	0
West North Central	5
West South Central	2
Mountain	2
Pacific	1
TOTAL	17

Table 39-81
Region By Class Classification For Institutions Currently Considering Heart Transplantation

	CLASS									
REGION	I	II	III	IV	V	VI	VII	VIII	O	TOTAL
Puerto Rico	0	0	0	0	0	0	0	0	1	1
New England	5	0	1	0	0	0	0	0	0	6
Mid Atlantic	3	0	3	0	1	0	0	0	5	12
South Atlantic	5	0	0	0	0	0	0	0	0	5
East North Central	12	0	2	0	1	1	1	0	1	18
East South Central	3	0	0	0	1	0	0	0	0	4
West North Central	2	0	0	0	1	0	1	0	5	9
West South Central	2	0	0	0	1	0	0	0	2	5
Mountain	1	0	0	0	0	0	0	0	2	3
Pacific	6	0	2	0	1	0	1	0	1	11
TOTAL	39	0	8	0	6	1	3	0	17	74

they are likely to consider or reconsider the possibility of doing heart transplants. Moreover, 27 or 6.5 percent of these institutions said that they will probably begin to do heart transplants within the next five years. Medicare funding of heart transplantation would clearly have a marked effect on whether institutions not currently considering heart transplantation will begin to do them. Of these 418 institutions, 4 or 1.0 percent said Medicare funding would make it a certainty, while 110 or 26.3 percent said it would increase the likelihood. Just over 70 percent of these institutions said Medicare funding would have no affect on their plans.

When asked whether any surgeons on their staff had performed or assisted with a heart transplant, 88 institutions (21.1 percent) answered yes, 309 (73.9 percent) said no, and 21 (5.0 percent) said they did not know.

Once again, to provide further insight into the qualifications of institutions not considering heart transplantation, we have prepared several descriptive tables. In Tables 39-82 through 39-89 data are provided on the volume of selected medical and surgical procedures, the number and distribution of selected medical specialties, and the extent of missing data on these institutions. Also, we have ranked these institutions according to our criteria. Tables 39-90 through 39-98 show the class by level rankings according to region of the country. Table 39-99 summarizes the rankings by Class. As shown, the majority (37.6 percent) are Class 0. Fifty-three or 12.7 percent qualify as Class I, while 2 are Class II, 42 are Class III, 4 are Class IV, 63 are Class V, 7 are Class VI, 70 are Class VII, and 20 are Class VIII.

Table 39-82
Descriptive Statistics On Four Medical and Surgical Procedures Performed At Institutions Not Currently Considering Heart Transplantation

	ALL INSTITUTIONS (N = 418)				
PROCEDURE	RANGE	MEAN	S.D.	MEDIAN	N
Adult Open-Heart Surgery	0-2200	294.5	249.0	247.0	405
Pediatric Open-Heart Surgery	0-360	15.2	42.7	.2	315
Kidney Transplants	0-64	3.5	11.1	.1	312
Cardiac Catheterizations	0-7106	876.0	743.1	717.0	383

Table 39-83
Number and Percent Distribution of Adult Open-Heart Surgical Procedures At Institutions Not Currently Considering Heart Transplantation

NUMBER OF PROCEDURES	ALL INSTITUTIONS (N=418) NUMBER	PERCENT
0	14	3.3
1 - 25	7	1.7
26 - 50	10	2.4
51 - 75	16	3.8
76 - 100	19	4.5
101 - 125	28	6.7
126 - 150	30	7.2
151 - 175	22	5.3
176 - 200	23	5.5
201 - 225	19	4.5
226 - 250	23	5.5
251 - 275	19	4.5
276 - 300	23	5.5
301 - 400	68	16.3
401 - 500	30	7.2
501 - 600	18	4.3
601 - 700	9	2.2
701 - 800	6	1.4
801 - 900	10	2.4
901 - 1000	2	0.5
1001+	9	2.2
UNKNOWN	13	3.1

Table 39-84
Number and Percent Distribution of Pediatric Open-Heart Surgical Procedures At Institutions Not Currently Considering Heart Transplantation

NUMBER OF PROCEDURES	ALL INSTITUTIONS (N=418) NUMBER	PERCENT
0	221	52.9
1 - 25	44	10.5
26 - 50	17	4.1
51 - 75	16	3.8
76 - 100	4	1.0
101 - 125	4	1.0
126 - 150	3	0.7
151 - 175	1	0.2
176 - 200	1	0.2
201 - 225	1	0.2
226 - 250	0	0.0
251 - 300	2	0.5
301+	1	0.2
UNKNOWN	103	24.6

Table 39-85
Number and Percent Distribution of Kidney Transplants
At Institutions Not Currently Considering
Heart Transplantation

NUMBER OF PROCEDURES	ALL INSTITUTIONS (N=418) NUMBER	PERCENT
0	271	64.8
1 - 25	26	6.2
26 - 50	8	1.9
51 - 75	7	1.7
76 - 100	0	0.0
101 - 125	0	0.0
126 - 150	0	0.0
151 - 175	0	0.0
176 - 200	0	0.0
201 - 225	0	0.0
UNKNOWN	106	25.4

Table 39-86
Number and Percent Distribution of Cardiac Catheterizations
At Institutions Not Currently Considering
Heart Transplantation

NUMBER OF PROCEDURES	ALL INSTITUTIONS (N=418) NUMBER	PERCENT
0	2	0.5
1 - 100	1	0.2
101 - 200	19	4.5
201 - 300	24	5.7
301 - 400	38	9.1
401 - 500	43	10.3
501 - 1000	152	36.4
1001 - 2000	82	19.6
2001 - 3000	15	3.6
3001 - 4000	3	0.7
4001 - 5000	3	0.7
5001 - 6000	0	0.0
6001 - 7000	0	0.0
7001 - 8000	1	0.2
UNKNOWN	35	8.4

Table 39-87
Missing Data Profile For Medical and Surgical Procedures--
Institutions Not Currently Considering
Heart Transplantation

	MISSING DATA	
PROCEDURE	NUMBER OF INSTITUTIONS	PERCENT OF ALL INSTITUTIONS
Adult Open-Heart Surgery	13	3.1
Pediatric Open-Heart Surgery	103	24.6
Kidney Transplants	106	25.4
Cardiac Catheterizations	35	8.4

Table 39-88
Descriptive Statistics On The Distribution of Medical Specialties
At Institutions Not Currently Considering
Heart Transplantation

	ALL INSTITUTIONS (N = 418)				
MEDICAL SPECIALTY	RANGE	MEAN	S.D.	MEDIAN	N
Anesthesiologists	0-51	11.5	8.8	9.00	386
Cardiologists	0-64	10.6	9.0	8.00	386
Cardiovascular Surgeons	0-29	5.3	4.6	4.00	380
Immunologists	0-12	1.2	1.9	1.00	310
Infectious Disease Specialists	0-14	2.2	1.9	2.00	352
Neurologists	0-62	5.5	5.5	4.00	368
Neurosurgeons	0-24	4.3	3.5	3.00	367
Pathologists	0-42	5.8	4.3	5.00	381
Transplant surgeons	0-10	.6	1.4	.02	295
Virologists	0-7	.4	.7	.07	284

Table 39-89
Missing Data Profile For Medical Specialties--
Institutions Not Currently Considering
Heart Transplantation

SPECIALTY	MISSING DATA	
	NUMBER OF INSTITUTIONS	PERCENT OF ALL INSTITUTIONS
Anesthesiologists	32	7.7
Cardiologists	32	7.7
Cardiovascular Surgeons	38	9.1
Immunologists	108	25.8
Infectious Disease Specialists	66	15.8
Neurologists	50	12.0
Neurosurgeons	51	12.2
Pathologists	37	8.9
Transplant Surgeons	123	29.4
Virologists	134	32.1

Table 39-90
Ranking of Institutions Not Currently Considering
Heart Transplantation: Class I

CLASS BY REGION	LEVEL				
CLASS I	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	1	0	0	0	1
Mid Atlantic	8	0	0	0	8
South Atlantic	6	0	5	1	12
East North Central	2	0	4	1	7
East South Central	4	0	0	1	5
West North Central	1	0	2	1	4
West South Central	2	0	1	1	4
Mountain	2	0	1	0	3
Pacific	6	0	2	1	9
TOTAL	32	0	15	6	53

Table 39-91
Ranking of Institutions Not Currently Considering
Heart Transplantation: Class II

CLASS BY REGION	LEVEL				
CLASS II	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	0	1	0	0	1
South Atlantic	0	0	0	0	0
East North Central	0	0	0	0	0
East South Central	0	0	0	0	0
West North Central	0	0	0	0	0
West South Central	0	0	0	0	0
Mountain	0	0	0	1	1
Pacific	0	0	0	0	0
TOTAL	0	1	0	1	2

Table 39-92
Ranking of Institutions Not Currently Considering
Heart Transplantation: Class III

CLASS BY REGION	LEVEL				
CLASS III	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	2	0	1	0	3
Mid Atlantic	5	0	1	1	7
South Atlantic	1	1	2	1	5
East North Central	6	0	2	2	10
East South Central	1	0	0	0	1
West North Central	1	0	0	1	2
West South Central	6	1	0	1	8
Mountain	3	0	0	0	3
Pacific	1	0	1	1	3
TOTAL	26	2	7	7	42

Table 39-93
Ranking of Institutions Not Currently Considering
Heart Transplantation: Class IV

CLASS BY REGION	LEVEL				
CLASS IV	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	0	0	0	0	0
South Atlantic	1	0	0	0	1
East North Central	0	0	0	0	0
East South Central	0	0	1	0	1
West North Central	1	0	0	0	1
West South Central	0	0	0	0	0
Mountain	0	0	0	0	0
Pacific	0	1	0	0	1
TOTAL	2	1	1	0	4

Table 39-94
Ranking of Institutions Not Currently Considering
Heart Transplantation: Class V

CLASS BY REGION	LEVEL				
CLASS V	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	2	1	0	1	4
Mid Atlantic	9	0	0	0	9
South Atlantic	1	0	4	1	6
East North Central	8	0	1	2	11
East South Central	3	0	1	0	4
West North Central	4	0	0	2	6
West South Central	1	0	2	1	4
Mountain	3	0	1	0	4
Pacific	9	0	3	3	15
TOTAL	40	1	12	10	63

Table 39-95
Ranking of Institutions Not Currently Considering
Heart Transplantation: Class VI

CLASS BY REGION	LEVEL				
CLASS VI	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	0	0	0	0	0
South Atlantic	1	0	0	0	1
East North Central	0	0	4	0	4
East South Central	0	0	1	0	1
West North Central	0	0	0	0	0
West South Central	1	0	0	0	1
Mountain	0	0	0	0	0
Pacific	0	0	0	0	0
TOTAL	2	0	5	0	7

Table 39-96
Ranking of Institutions Not Currently Considering
Heart Transplantation: Class VII

CLASS BY REGION	LEVEL				
CLASS VII	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	1	0	0	0	1
Mid Atlantic	5	0	0	0	5
South Atlantic	8	0	5	1	14
East North Central	11	0	4	1	16
East South Central	6	0	0	0	6
West North Central	3	0	1	0	4
West South Central	4	0	3	1	8
Mountain	0	0	2	1	3
Pacific	8	0	1	4	13
TOTAL	46	0	16	8	70

Table 39-97
Ranking of Institutions Not Currently Considering
Heart Transplantation: Class VIII

CLASS BY REGION	LEVEL				
CLASS VIII	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	0	0	0	0	0
South Atlantic	1	0	0	3	4
East North Central	2	0	1	0	3
East South Central	0	0	2	1	3
West North Central	2	0	0	1	3
West South Central	3	0	0	1	4
Mountain	0	0	0	1	1
Pacific	1	0	1	0	2
TOTAL	9	0	4	7	20

Table 39-98
Ranking of Institutions Not Currently Considering
Heart Transplantation: Class O

CLASS BY REGION	LEVEL UNSPECIFIED
CLASS O	
Puerto Rico	3
New England	4
Mid Atlantic	14
South Atlantic	26
East North Central	23
East South Central	7
West North Central	13
West South Central	24
Mountain	15
Pacific	28
TOTAL	157

Table 39-99
Region By Class Classification For Institutions Not Currently Considering Heart Transplantation

	CLASS									
REGION	I	II	III	IV	V	VI	VII	VIII	O	TOTAL
Puerto Rico	0	0	0	0	0	0	0	0	3	3
New England	1	0	3	0	4	0	1	0	4	13
Mid Atlantic	8	1	7	0	9	0	5	0	14	44
South Atlantic	12	0	5	1	6	1	14	4	26	69
East North Central	7	0	10	0	11	4	16	3	23	74
East South Central	5	0	1	1	4	1	6	3	7	28
West North Central	4	0	2	1	6	0	4	3	13	33
West South Central	4	0	8	0	4	1	8	4	24	53
Mountain	3	1	3	0	4	0	3	1	15	30
Pacific	9	0	3	1	15	0	13	2	28	71
TOTAL	53	2	42	4	63	7	70	20	157	418

e. Group 5. Institutions That Will Begin Heart Transplantation Within The Next Five Years. Of those institutions that said they were going to embark on heart transplantation within the next five years (N = 91), 63 or 69.2 percent said they were currently considering heart transplantation. Medicare funding would clearly have an affect on the decision of these institutions as 16 (17.6 percent) said that they would certainly start and 51 (56 percent) said they would be more likely to start if Medicare were to cover heart transplantation.

Many of these institutions (44 or 48.4 percent) have surgeons on their staffs that have performed or assisted with a heart transplant, thus, this could be a primary motivating factor. A collection of tables has, once again, been assembled here to provide additional descriptive data on these institutions. In Tables 39-100 through 39-107, we have provided data on the volume of selected medical and surgical procedures, the number and distribution of selected medical specialties, and the extent of missing data on these institutions. Also, we have ranked these centers according to our class and level criteria as shown in Tables 39-108 through 39-116. Clearly the majority (39.6 percent) of these institutions are Class I, Level A. Over 50 percent are Class I. As summarized in Table 39-117, 45 are Class I, 11 are Class III, 7 are Class V, 1 is Class VI, 1 is Class VII, and 25 are Class O. It is again unfortunate that 27.4 percent of these institutions fall in Class O, the majority of which do so because of missing data.

Table 39-100
Descriptive Statistics On Four Medical and Surgical Procedures
Performed At Institutions That Will Begin Heart
Transplantation Within The Next Five Years

	ALL INSTITUTIONS (N = 91)				
PROCEDURE	RANGE	MEAN	S.D.	MEDIAN	N
Adult Open-Heart Surgery	0-2200	484.1	403.8	351.5	88
Pediatric Open-Heart Surgery	0-360	59.5	81.5	29.0	77
Kidney Transplants	0-159	27.6	31.7	17.0	77
Cardiac Catheterizations	118-5000	1166.1	940.6	965.5	84

Table 39-101
Number and Percent Distribution of Adult Open-Heart Surgical Procedures At Institutions That Will Begin Heart Transplantation Within The Next Five Years

NUMBER OF PROCEDURES	ALL INSTITUTIONS (N=91) NUMBER	PERCENT
0	4	4.4
1 - 25	1	1.1
26 - 50	3	3.3
51 - 75	1	1.1
76 - 100	2	2.2
101 - 125	3	3.3
126 - 150	0	0.0
151 - 175	4	4.4
176 - 200	7	7.7
201 - 225	6	6.6
226 - 250	4	4.4
251 - 275	3	3.3
276 - 300	1	1.1
301 - 400	8	8.8
401 - 500	7	7.7
501 - 600	8	8.8
601 - 700	2	2.2
701 - 800	5	5.5
801 - 900	4	4.4
901 - 1000	6	6.6
1001+	9	9.9
UNKNOWN	3	3.3

Table 39-102
Number and Percent Distribution of Pediatric Open-Heart Surgical Procedures At Institutions That Will Begin Heart Transplantation Within The Next Five Years

NUMBER OF PROCEDURES	ALL INSTITUTIONS (N=91) NUMBER	PERCENT
0	26	28.6
1 - 25	12	13.2
26 - 50	8	8.8
51 - 75	9	9.9
76 - 100	7	7.7
101 - 125	3	3.3
126 - 150	3	3.3
151 - 175	4	4.4
176 - 200	0	0.0
201 - 225	0	0.0
226 - 250	1	1.1
251 - 300	2	2.2
301+	2	2.2
UNKNOWN	14	15.4

Table 39-103
Number and Percent Distribution of Kidney Transplants
At Institutions That Will Begin Heart
Transplantation Within The Next Five Years

NUMBER OF PROCEDURES	ALL INSTITUTIONS (N=91) NUMBER	PERCENT
0	26	28.6
1 - 25	20	22.0
26 - 50	14	15.4
51 - 75	12	13.2
76 - 100	4	4.4
101 - 125	0	0.0
126 - 150	0	0.0
151 - 175	1	1.1
176 - 200	0	0.0
201 - 225	0	0.0
UNKNOWN	14	15.4

Table 39-104
Number and Percent Distribution of Cardiac Catheterizations
At Institutions That Will Begin Heart Transplantation
Within The Next Five Years

NUMBER OF PROCEDURES	ALL INSTITUTIONS (N=91) NUMBER	PERCENT
0	0	0.0
1 - 100	0	0.0
101 - 200	4	4.4
201 - 300	4	4.4
301 - 400	6	6.6
401 - 500	5	5.5
501 - 1000	26	28.6
1001 - 2000	27	29.7
2001 - 3000	8	8.8
3001 - 4000	2	2.2
4001 - 5000	2	2.2
5001 - 6000	0	0.0
6001 - 7000	0	0.0
7001 - 8000	0	0.0
UNKNOWN	7	7.7

Table 39-105
Missing Data Profile For Medical and Surgical Procedures--
Institutions That Will Begin Heart Transplantation
Within The Next Five Years

	MISSING DATA	
PROCEDURE	NUMBER OF INSTITUTIONS	PERCENT OF ALL INSTITUTIONS
Adult Open-Heart Surgery	3	3.3
Pediatric Open-Heart Surgery	14	15.4
Kidney Transplants	14	15.4
Cardiac Catheterizations	7	7.7

Table 39-106
Descriptive Statistics On The Distribution of Medical Specialties
At Institutions That Will Begin Heart Transplantation
Within The Next Five Years

	ALL INSTITUTIONS (N = 91)				
MEDICAL SPECIALTY	RANGE	MEAN	S.D.	MEDIAN	N
Anesthesiologists	0.5-145	17.7	20.0	12.0	90
Cardiologists	0.0-75	13.9	13.3	9.0	90
Cardiovascular surgeons	0.0-29	5.4	4.5	4.0	90
Immunologists	0.0-21	2.5	2.9	2.0	82
Infectious Disease Specialists	0.0-13	3.9	2.8	3.0	89
Neurologists	0.0-62	8.4	9.2	5.9	88
Neurosurgeons	0.0-21	5.0	4.1	4.0	88
Pathologists	1.0-60	11.3	10.1	7.0	89
Transplant Surgeons	0.0-10	2.0	1.9	1.0	79
Virologists	0.0-5	1.0	1.1	.9	67

Table 39-107
Missing Data Profile For Medical and Surgical Specialties--
Institutions That Will Begin Heart Transplantation
Within The Next Five Years

	MISSING DATA	
SPECIALTY	NUMBER OF INSTITUTIONS	PERCENT OF ALL INSTITUTIONS
Anesthesiologists	1	1.1
Cardiologists	1	1.1
Cardiovascular Surgeons	1	1.1
Immunologists	9	9.9
Infectious Disease Specialists	2	2.2
Neurologists	3	3.3
Neurosurgeons	3	3.3
Pathologists	2	2.2
Transplant Surgeons	12	13.2
Virologists	24	26.4

Table 39-108
Ranking of Institutions That Will Begin Heart Transplantation
Within The Next Five Years: Class I

CLASS BY REGION	LEVEL				
CLASS I	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	4	0	0	0	4
Mid Atlantic	4	1	0	0	5
South Atlantic	8	0	2	0	10
East North Central	9	0	1	1	11
East South Central	3	0	0	1	4
West North Central	3	0	0	0	3
West South Central	1	0	1	0	2
Mountain	1	0	0	0	1
Pacific	3	1	2	0	6
TOTAL	36	2	6	2	46

Table 39-109
Ranking of Institutions That Will Begin Heart Transplantation
Within The Next Five Years: Class II

CLASS BY REGION	LEVEL				
CLASS II	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	0	0	0	0	0
South Atlantic	0	0	0	0	0
East North Central	0	0	0	0	0
East South Central	0	0	0	0	0
West North Central	0	0	0	0	0
West South Central	0	0	0	0	0
Mountain	0	0	0	0	0
Pacific	0	0	0	0	0
TOTAL	0	0	0	0	0

Table 39-110
Ranking of Institutions That Will Begin Heart Transplantation
Within The Next Five Years: Class III

CLASS BY REGION	LEVEL				
CLASS III	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	1	0	0	0	1
Mid Atlantic	2	0	2	0	4
South Atlantic	0	0	0	0	0
East North Central	1	0	1	0	2
East South Central	0	0	0	0	0
West North Central	0	0	0	0	0
West South Central	0	1	0	0	1
Mountain	0	0	0	0	0
Pacific	3	0	0	0	3
TOTAL	7	1	3	0	11

Table 39-111
Ranking of Institutions That Will Begin Heart Transplantation
Within The Next Five Years: Class IV

CLASS BY REGION	LEVEL				
CLASS IV	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	0	0	0	0	0
South Atlantic	0	0	0	0	0
East North Central	0	0	0	0	0
East South Central	0	0	0	0	0
West North Central	0	0	0	0	0
West South Central	0	0	0	0	0
Mountain	0	0	0	0	0
Pacific	0	0	0	0	0
TOTAL	0	0	0	0	0

Table 39-112
Ranking of Institutions That Will Begin Heart Transplantation
Within The Next Five Years: Class V

CLASS BY REGION	LEVEL				
CLASS V	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	1	0	0	1	2
Mid Atlantic	1	0	0	0	1
South Atlantic	0	0	0	0	0
East North Central	1	0	0	0	1
East South Central	1	0	0	0	1
West North Central	0	0	1	0	1
West South Central	0	0	1	0	1
Mountain	0	0	0	0	0
Pacific	0	0	0	0	0
TOTAL	4	0	2	1	7

Table 39-113
Ranking of Institutions That Will Begin Heart Transplantation
Within The Next Five Years: Class VI

CLASS BY REGION	LEVEL				
CLASS VI	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	0	0	0	0	0
South Atlantic	0	0	0	0	0
East North Central	0	0	1	0	1
East South Central	0	0	0	0	0
West North Central	0	0	0	0	0
West South Central	0	0	0	0	0
Mountain	0	0	0	0	0
Pacific	0	0	0	0	0
TOTAL	0	0	1	0	1

Table 39-114
Ranking of Institutions That Will Begin Heart Transplantation
Within The Next Five Years: Class VII

CLASS BY REGION	LEVEL				
CLASS VII	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	0	0	0	0	0
South Atlantic	0	0	0	0	0
East North Central	0	0	0	0	0
East South Central	0	0	0	0	0
West North Central	0	0	1	0	1
West South Central	0	0	0	0	0
Mountain	0	0	0	0	0
Pacific	0	0	0	0	0
TOTAL	0	0	1	0	1

Table 39-115
Ranking of Institutions That Will Begin Heart Transplantation
Within The Next Five Years: Class VIII

CLASS BY REGION	LEVEL				
CLASS VIII	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	0	0	0	0	0
South Atlantic	0	0	0	0	0
East North Central	0	0	0	0	0
East South Central	0	0	0	0	0
West North Central	0	0	0	0	0
West South Central	0	0	0	0	0
Mountain	0	0	0	0	0
Pacific	0	0	0	0	0
TOTAL	0	0	0	0	0

Table 39-116
Ranking of Institutions That Will Begin Heart Transplantation
Within The Next Five Years: Class O

CLASS BY REGION	LEVEL UNSPECIFIED
CLASS O	
Puerto Rico	2
New England	1
Mid Atlantic	6
South Atlantic	1
East North Central	2
East South Central	0
West North Central	6
West South Central	2
Mountain	3
Pacific	2
TOTAL	25

Table 39-117
Region By Class Classification For Those Institutions That Will Begin Heart Transplantation Within Next Five Years

	CLASS									
REGION	I	II	III	IV	V	VI	VII	VIII	O	TOTAL
Puerto Rico	0	0	0	0	0	0	0	0	2	2
New England	4	0	1	0	2	0	0	0	1	8
Mid Atlantic	5	0	4	0	1	0	0	0	6	16
South Atlantic	10	0	0	0	0	0	0	0	1	11
East North Central	11	0	2	0	1	1	0	0	2	17
East South Central	4	0	0	0	1	0	0	0	0	5
West North Central	3	0	0	0	1	0	0	0	6	10
West South Central	2	0	1	0	1	0	1	0	2	6
Mountain	1	0	0	0	0	0	0	0	3	4
Pacific	6	0	3	0	0	0	0	0	2	11
TOTAL	46	0	11	0	7	1	1	0	25	91

f. Group 6. Institutions That Are Certain To Begin Heart Transplantation With Medicare Coverage. Quite surprisingly, only 19 institutions indicated that with Medicare coverage of heart transplantation they would certainly start a program. Of these 19 institutions, 14 (73.7 percent) were already considering heart transplantation, and 16 (84.2 percent) said they would begin doing them within the next five years.

The majority (12 or 63.2 percent) of these institutions indicated that they had surgeons on their staff that had performed or assisted with a heart transplant. To provide further insight into the qualifications of these 19 institutions that are certain to begin heart transplantation with Medicare coverage, we have again provided a collection of tables that contain data on their volume of selected medical and surgical procedures, their number and distribution of selected medical specialties, and the extent of missing data associated with them (see Tables 39-118 through 39-125). Also, the centers have been ranked according to our class and level criteria (see Tables 39-126 through 39-135). As shown in Table 39-126, 13 or 68.4 percent of these institutions are Class I, all of which are Level A. Of the remaining institutions, 3 are Class III, 2 are Class V, and 1 is Class O (see Table 39-135).

g. Group 7. Institutions That Are Likely To Begin Heart Transplantation With Medicare Coverage. A much larger number of institutions (N = 151) said that Medicare coverage of heart transplants would increase the likelihood that they would begin to do them. Of these 151 institutions, only 41 or 27.2 percent said they

Table 39-118
Descriptive Statistics On Four Medical and Surgical Procedures
Performed At Institutions That Are Certain To Begin
Heart Transplantation With Medicare Coverage

	ALL INSTITUTIONS (N = 19)				
PROCEDURE	RANGE	MEAN	S.D.	MEDIAN	N
Adult Open-Heart Surgery	100-1657	565.2	397.6	496.0	19
Pediatric Open-Heart Surgery	0-300	58.3	80.1	30.0	14
Kidney Transplants	0-65	29.4	22.1	27.5	16
Cardiac Catheterizations	120-3202	1198.3	692.7	1106.0	19

Table 39-119
Number and Percent Distribution of Adult Open-Heart Surgical Procedures At Institutions That Are Certain To Begin Heart Transplantation With Medicare Coverage

NUMBER OF PROCEDURES	ALL INSTITUTIONS (N=19) NUMBER	PERCENT
0	0	0.0
1 - 25	0	0.0
26 - 50	0	0.0
51 - 75	0	0.0
76 - 100	1	5.3
101 - 125	0	0.0
126 - 150	0	0.0
151 - 175	1	5.3
176 - 200	1	5.3
201 - 225	0	0.0
226 - 250	1	5.3
251 - 275	1	5.3
276 - 300	0	0.0
301 - 400	3	15.8
401 - 500	3	15.8
501 - 600	2	10.5
601 - 700	1	5.3
701 - 800	1	5.3
801 - 900	1	5.3
901 - 1000	1	5.3
1001+	2	10.5
UNKNOWN		

Table 39-120
Number and Percent Distribution of Pediatric Open-Heart Surgical Procedures At Institutions That Are Certain To Begin Heart Transplantation With Medicare Coverage

NUMBER OF PROCEDURES	ALL INSTITUTIONS (N=19) NUMBER	PERCENT
0	2	10.5
1 - 25	4	21.1
26 - 50	4	21.1
51 - 75	1	5.3
76 - 100	1	5.3
101 - 125	0	0.0
126 - 150	1	5.3
151 - 175	0	0.0
176 - 200	0	0.0
201 - 225	0	0.0
226 - 250	0	0.0
251 - 300	1	5.3
301+	0	0.0
UNKNOWN	5	26.3

Table 39-121
Number and Percent Distribution of Kidney Transplants At Institutions That Are Certain To Begin Heart Transplantation With Medicare Coverage

NUMBER OF PROCEDURES	ALL INSTITUTIONS (N=19) NUMBER	PERCENT
0	3	15.8
1 - 25	4	21.1
26 - 50	6	31.6
51 - 75	3	15.8
76 - 100	0	0.0
101 - 125	0	0.0
126 - 150	0	0.0
151 - 175	0	0.0
176 - 200	0	0.0
201 - 225	0	0.0
UNKNOWN	3	15.8

Table 39-122
Number and Percent Distribution of Cardiac Catheterizations
At Institutions That Are Certain To Begin Heart
Transplantation With Medicare Coverage

NUMBER OF PROCEDURES	ALL INSTITUTIONS (N=19) NUMBER	PERCENT
0	0	0.0
1 - 100	0	0.0
101 - 200	1	5.3
201 - 300	0	0.0
301 - 400	0	0.0
401 - 500	0	0.0
501 - 1000	7	36.8
1001 - 2000	8	42.1
2001 - 3000	2	10.5
3001 - 4000	1	5.3
4001 - 5000	0	0.0
5001 - 6000	0	0.0
6001 - 7000	0	0.0
7001 - 8000	0	0.0
UNKNOWN	0	0.0

Table 39-123
Missing Data Profile For Medical and Surgical Procedures--
Institutions That Are Certain To Begin Heart
Transplantation With Medicare Coverage

	MISSING DATA	
PROCEDURE	NUMBER OF INSTITUTIONS	PERCENT OF ALL INSTITUTIONS
Adult Open-Heart Surgery	0	0.0
Pediatric Open-Heart Surgery	5	26.3
Kidney Transplants	3	15.8
Cardiac Catheterizations	0	0.0

Table 39-124
Descriptive Statistics On The Distribution of Medical Specialties
At Institutions That Are Certain To Begin Heart
Transplantation With Medicare Coverage

	ALL INSTITUTIONS (N = 19)				
MEDICAL SPECIALTY	RANGE	MEAN	S.D.	MEDIAN	N
Anesthesiologists	6-145	22.8	30.5	15.0	19
Cardiologists	4-33	12.4	8.0	9.9	19
Cardiovascular Surgeons	2-17	6.2	4.6	4.7	19
Immunologists	0-21	3.1	4.8	1.9	17
Infectious Disease Specialists	1-10	3.9	2.9	3.0	19
Neurologists	2-21	7.3	5.2	6.0	19
Neurosurgeons	2-11	5.1	3.0	4.3	19
Pathologists	3-24	10.8	5.9	10.3	19
Transplant Surgeons	0-6	2.3	1.8	2.1	16
Virologists	0-2	1.1	0.5	1.1	13

Table 39-125
Missing Data Profile For Medical and Surgical Specialties--
Institutions That Are Certain To Begin Heart
Transplantation Within The Next Five Years

	MISSING DATA	
SPECIALTY	NUMBER OF INSTITUTIONS	PERCENT OF ALL INSTITUTIONS
Anesthesiologists	0	0.0
Cardiologists	0	0.0
Cardiovascular Surgeons	0	0.0
Immunologists	2	10.5
Infectious Disease Specialists	0	0.0
Neurologists	0	0.0
Neurosurgeons	0	0.0
Pathologists	0	0.0
Transplant Surgeons	3	15.8
Virologists	6	31.6

Table 39-126
Ranking of Institutions That Are Certain To Begin Heart Transplantation With Medicare Coverage: Class I

CLASS BY REGION	LEVEL				
CLASS I	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	1	0	0	0	1
South Atlantic	2	0	0	0	2
East North Central	4	0	0	0	4
East South Central	2	0	0	0	2
West North Central	0	0	0	0	0
West South Central	1	0	0	0	1
Mountain	0	0	0	0	0
Pacific	3	0	0	0	3
TOTAL	13	0	0	0	13

Table 39-127
Ranking of Institutions That Are Certain To Begin Heart Transplantation With Medicare Coverage: Class II

CLASS BY REGION	LEVEL				
CLASS II	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	0	0	0	0	0
South Atlantic	0	0	0	0	0
East North Central	0	0	0	0	0
East South Central	0	0	0	0	0
West North Central	0	0	0	0	0
West South Central	0	0	0	0	0
Mountain	0	0	0	0	0
Pacific	0	0	0	0	0
TOTAL	0	0	0	0	0

Table 39-128
Ranking of Institutions That Are Certain To Begin Heart Transplantation With Medicare Coverage: Class III

CLASS BY REGION	LEVEL				
CLASS III	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	1	0	0	0	1
Mid Atlantic	1	0	0	0	1
South Atlantic	0	0	0	0	0
East North Central	1	0	0	0	1
East South Central	0	0	0	0	0
West North Central	0	0	0	0	0
West South Central	0	0	0	0	0
Mountain	0	0	0	0	0
Pacific	0	0	0	0	0
TOTAL	3	0	0	0	3

Table 39-129
Ranking of Institutions That Are Certain To Begin Heart Transplantation With Medicare Coverage: Class IV

CLASS BY REGION	LEVEL				
CLASS IV	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	0	0	0	0	0
South Atlantic	0	0	0	0	0
East North Central	0	0	0	0	0
East South Central	0	0	0	0	0
West North Central	0	0	0	0	0
West South Central	0	0	0	0	0
Mountain	0	0	0	0	0
Pacific	0	0	0	0	0
TOTAL	0	0	0	0	0

Table 39-130
Ranking of Institutions That Are Certain To Begin Heart Transplantation With Medicare Coverage: Class V

CLASS BY REGION	LEVEL				
CLASS V	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	1
Mid Atlantic	0	0	0	0	0
South Atlantic	0	0	0	0	0
East North Central	0	0	0	0	0
East South Central	0	0	0	0	0
West North Central	0	0	1	0	1
West South Central	0	0	0	0	0
Mountain	0	0	0	0	0
Pacific	0	0	0	0	0
TOTAL	1	0	1	0	2

Table 39-131
Ranking of Institutions That Are Certain To Begin Heart Transplantation With Medicare Coverage: Class VI

CLASS BY REGION	LEVEL				
CLASS VI	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	0	0	0	0	0
South Atlantic	0	0	0	0	0
East North Central	0	0	0	0	0
East South Central	0	0	0	0	0
West North Central	0	0	0	0	0
West South Central	0	0	0	0	0
Mountain	0	0	0	0	0
Pacific	0	0	0	0	0
TOTAL	0	0	0	0	0

Table 39-132
Ranking of Institutions That Are Certain To Begin Heart Transplantation With Medicare Coverage: Class VII

CLASS BY REGION	LEVEL				
CLASS VII	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	0	0	0	0	0
South Atlantic	0	0	0	0	0
East North Central	0	0	0	0	0
East South Central	0	0	0	0	0
West North Central	0	0	0	0	0
West South Central	0	0	0	0	0
Mountain	0	0	0	0	0
Pacific	0	0	0	0	0
TOTAL	0	0	0	0	0

Table 39-133
Ranking of Institutions That Are Certain To Begin Heart Transplantation With Medicare Coverage: Class VIII

CLASS BY REGION	LEVEL				
CLASS VIII	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	0	0	0	0	0
South Atlantic	0	0	0	0	0
East North Central	0	0	0	0	0
East South Central	0	0	0	0	0
West North Central	0	0	0	0	0
West South Central	0	0	0	0	0
Mountain	0	0	0	0	0
Pacific	0	0	0	0	0
TOTAL	0	0	0	0	0

Table 39-134
Ranking of Institutions That Are Certain To Begin Heart Transplantation With Medicare Coverage: Class O

CLASS BY REGION	LEVEL UNSPECIFIED
CLASS O	
Puerto Rico	0
New England	0
Mid Atlantic	0
South Atlantic	0
East North Central	0
East South Central	0
West North Central	0
West South Central	0
Mountain	1
Pacific	0
TOTAL	1

Table 39-135
Region By Class Classification For All Institutions That Are Certain To Begin Heart Transplantation With Medicare Coverage

	CLASS									
REGION	I	II	III	IV	V	VI	VII	VIII	O	TOTAL
Puerto Rico	0	0	0	0	0	0	0	0	0	0
New England	0	0	1	0	1	0	0	0	0	2
Mid Atlantic	1	0	1	0	0	0	0	0	0	2
South Atlantic	2	0	0	0	0	0	0	0	0	2
East North Central	4	0	1	0	0	0	0	0	0	5
East South Central	2	0	0	0	0	0	0	0	0	2
West North Central	0	0	0	0	1	0	0	0	0	1
West South Central	1	0	0	0	0	0	0	0	0	1
Mountain	0	0	0	0	0	0	0	0	1	1
Pacific	3	0	0	0	0	0	0	0	0	3
TOTAL	13	0	3	0	2	0	0	0	1	19

were currently considering heart transplants, however. Moreover, 31 of these institutions said they would begin to consider heart transplantation in the near future, and 51 or 33.8 percent said they would begin doing heart transplants within 5 years.

Again a sizeable number (N = 53, 35.1 percent) of these institutions indicated that a surgeon on their staff had either performed or assisted with a heart transplant. As shown in Tables 39-136 through 39-143, many of these institutions have the staff and facilities required for heart transplantation. Also, when ranked according to our class and level criteria, many of these institutions fare well. As shown in Tables 39-144 through 39-152, a large proportion of these institutions are Class I. In fact, 28.5 percent are Class I, the majority of which are Level A. Unfortunately, 50 institutions are Class 0. As shown in Table 39-153, of the remaining centers, 18 are Class III, 1 is Class IV, 18 are Class V, 1 is Class VI, 17 are Class VII, and 3 are Class VIII.

E. CONCLUSION

The results presented here show that over the next five years there is likely to be a considerable increase in the number of hospitals and medical centers in the United States that embark on heart transplantation. We estimate that in addition to the 20 active heart transplant programs, as many as 8 inactive programs will once again begin heart transplantation. Seventy-four institutions are currently considering heart transplantation, while 91 indicate that they will begin heart transplantation with the next five years. With

Table 39-136
Descriptive Statistics On Four Medical and Surgical Procedures
Performed At Institutions That Are Likely To Begin
Heart Transplantation With Medicare Coverage

	ALL INSTITUTIONS (N = 151)				
PROCEDURE	RANGE	MEAN	S.D.	MEDIAN	N
Adult Open-Heart Surgery	0-2200	395.7	329.8	301.5	150
Pediatric Open-Heart Surgery	0-360	30.2	63.3	.4	122
Kidney Transplants	0-159	13.7	27.2	.3	121
Cardiac Catheterizations	118-5000	1053.6	776.0	889.6	139

Table 39-137
Number and Percent Distribution of Adult Open-Heart Surgical Procedures At Institutions That Are Likely To Begin Heart Transplantation With Medicare Coverage

NUMBER OF PROCEDURES	ALL INSTITUTIONS (N=151) NUMBER	PERCENT
0	4	2.6
1 - 25	3	2.0
26 - 50	4	2.6
51 - 75	5	3.3
76 - 100	5	3.3
101 - 125	5	3.3
126 - 150	4	2.6
151 - 175	7	4.6
176 - 200	3	2.0
201 - 225	8	5.3
226 - 250	7	4.6
251 - 275	7	4.6
276 - 300	12	7.9
301 - 400	25	16.6
401 - 500	15	9.9
501 - 600	9	6.0
601 - 700	2	1.3
701 - 800	6	4.0
801 - 900	6	4.0
901 - 1000	5	3.3
1001+	8	5.3
UNKNOWN	1	0.7

Table 39-138
Number and Percent Distribution of Pediatric Open-Heart Surgical Procedures At Institutions That Are Likely To Begin Heart Transplantation With Medicare Coverage

NUMBER OF PROCEDURES	ALL INSTITUTIONS (N=151) NUMBER	PERCENT
0	68	45.0
1 - 25	22	14.6
26 - 50	5	3.3
51 - 75	11	7.3
76 - 100	6	4.0
101 - 125	2	1.3
126 - 150	1	0.7
151 - 175	2	1.3
176 - 200	1	0.7
201 - 225	0	0.0
226 - 250	1	0.7
251 - 300	2	1.3
301+	1	0.7
UNKNOWN	29	19.2

Table 39-139
Number and Percent Distribution of Kidney Transplants At Institutions That Are Likely To Begin Heart Transplantation With Medicare Coverage

NUMBER OF PROCEDURES	ALL INSTITUTIONS (N=151) NUMBER	PERCENT
0	80	53.0
1 - 25	19	12.6
26 - 50	8	5.3
51 - 75	9	6.0
76 - 100	4	2.6
101 - 125	0	0.0
126 - 150	0	0.0
151 - 175	1	0.7
176 - 200	0	0.0
201 - 225	0	0.0
UNKNOWN	30	19.9

Table 39-140
Number and Percent Distribution of Cardiac Catheterizations
At Institutions That Are Likely To Begin Heart
Transplantation With Medicare Coverage

NUMBER OF PROCEDURES	ALL INSTITUTIONS (N=151) NUMBER	PERCENT
0	0	0.0
1 - 100	0	0.0
101 - 200	6	4.0
201 - 300	7	4.6
301 - 400	6	4.0
401 - 500	10	6.6
501 - 1000	53	35.1
1001 - 2000	46	30.5
2001 - 3000	7	4.6
3001 - 4000	2	1.3
4001 - 5000	2	1.3
5001 - 6000	0	0.0
6001 - 7000	0	0.0
7001 - 8000	0	0.0
UNKNOWN	12	7.9

Table 39-141
Missing Data Profile For Medical and Surgical Procedures--
Institutions That Are Likely To Begin Heart
Transplantation With Medicare Coverage

	MISSING DATA	
PROCEDURE	NUMBER OF INSTITUTIONS	PERCENT OF ALL INSTITUTIONS
Adult Open-Heart Surgery	1	0.7
Pediatric Open-Heart Surgery	29	19.2
Kidney Transplants	30	19.9
Cardiac Catheterizations	12	7.9

Table 39-142
Descriptive Statistics On The Distribution of Medical Specialties
At Institutions That Are Likely To Begin Heart
Transplantation With Medicare Coverage

	ALL INSTITUTIONS (N = 151)				
MEDICAL SPECIALTY	RANGE	MEAN	S.D.	MEDIAN	N
Anesthesiologists	0-101	14.5	13.8	10.0	142
Cardiologists	0-75	13.1	11.7	10.0	142
Cardiovascular Surgeons	0-29	5.8	4.8	4.2	141
Immunologists	0-12	2.0	2.4	1.1	121
Infectious Disease Specialists	0-14	2.9	2.4	2.2	135
Neurologists	0-62	7.0	8.2	4.9	136
Neurosurgeons	0-23	4.7	4.1	4.0	136
Pathologists	0-60	8.4	8.4	5.8	139
Transplant Surgeons	0-10	1.2	1.8	.2	121
Virologists	0-7	.7	1.3	.1	107

Table 39-143
Missing Data Profile For Medical and Surgical Specialties--
Institutions That Are Likely To Begin Heart
Transplantation With Medicare Coverage

	MISSING DATA	
SPECIALTY	NUMBER OF INSTITUTIONS	PERCENT OF ALL INSTITUTIONS
Anesthesiologists	9	6.0
Cardiologists	9	6.0
Cardiovascular Surgeons	10	6.6
Immunologists	30	19.9
Infectious Disease Specialists	16	10.6
Neurologists	15	9.9
Neurosurgeons	15	9.9
Pathologists	12	7.9
Transplant Surgeons	30	19.9
Virologists	44	29.1

Table 39-144
Ranking of Institutions That Are Likely To Begin Heart Transplantation With Medicare Coverage: Class I

CLASS BY REGION	LEVEL				
CLASS I	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	5	0	0	0	5
Mid Atlantic	4	1	0	0	5
South Atlantic	5	0	2	0	7
East North Central	7	0	1	0	8
East South Central	3	0	0	0	3
West North Central	3	0	1	0	4
West South Central	1	0	0	0	1
Mountain	3	0	1	0	4
Pacific	2	1	2	1	6
TOTAL	33	2	7	1	43

Table 39-145
Ranking of Institutions That Are Likely To Begin Heart Transplantation With Medicare Coverage: Class II

CLASS BY REGION	LEVEL				
CLASS II	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	0	0	0	0	0
South Atlantic	0	0	0	0	0
East North Central	0	0	0	0	0
East South Central	0	0	0	0	0
West North Central	0	0	0	0	0
West South Central	0	0	0	0	0
Mountain	0	0	0	0	0
Pacific	0	0	0	0	0
TOTAL	0	0	0	0	0

Table 39-146
Ranking of Institutions That Are Likely To Begin Heart Transplantation With Medicare Coverage: Class III

CLASS BY REGION	LEVEL				
CLASS III	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	1	0	0	0	1
Mid Atlantic	4	0	1	0	5
South Atlantic	0	1	1	0	2
East North Central	2	0	1	0	3
East South Central	1	0	0	0	1
West North Central	0	0	0	0	0
West South Central	1	0	0	0	1
Mountain	2	0	0	0	2
Pacific	2	0	0	1	3
TOTAL	13	1	3	1	18

Table 39-147
Ranking of Institutions That Are Likely To Begin Heart Transplantation With Medicare Coverage: Class IV

CLASS BY REGION	LEVEL				
CLASS IV	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	0	0	0	0	0
South Atlantic	0	0	0	0	0
East North Central	0	0	0	0	0
East South Central	0	0	0	0	0
West North Central	1	0	0	0	1
West South Central	0	0	0	0	0
Mountain	0	0	0	0	0
Pacific	0	0	0	0	0
TOTAL	1	0	0	0	1

Table 39-148
Ranking of Institutions That Are Likely To Begin Heart Transplantation With Medicare Coverage: Class V

CLASS BY REGION	LEVEL				
CLASS V	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	4	0	0	0	4
South Atlantic	0	0	0	0	0
East North Central	3	0	0	0	3
East South Central	2	0	0	0	2
West North Central	2	0	0	2	4
West South Central	1	0	0	0	1
Mountain	1	0	0	0	1
Pacific	3	0	0	0	3
TOTAL	16	0	0	2	18

Table 39-149
Ranking of Institutions That Are Likely To Begin Heart Transplantation With Medicare Coverage: Class VI

CLASS BY REGION	LEVEL				
CLASS VI	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	0	0	0	0	0
South Atlantic	0	0	0	0	0
East North Central	0	0	0	0	0
East South Central	0	0	1	0	1
West North Central	0	0	0	0	0
West South Central	0	0	0	0	0
Mountain	0	0	0	0	0
Pacific	0	0	0	0	0
TOTAL	0	0	1	0	1

Table 39-150
Ranking of Institutions That Are Likely To Begin Heart Transplantation With Medicare Coverage: Class VII

CLASS BY REGION	LEVEL				
CLASS VII	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	0	0	0	0	0
South Atlantic	3	0	1	0	4
East North Central	3	0	2	0	5
East South Central	2	0	0	0	2
West North Central	1	0	1	0	2
West South Central	1	0	0	0	1
Mountain	0	0	0	0	0
Pacific	3	0	0	0	3
TOTAL	13	0	4	0	17

Table 39-151
Ranking of Institutions That Are Likely To Begin Heart Transplantation With Medicare Coverage: Class VIII

CLASS BY REGION	LEVEL				
CLASS VIII	A	B	C	D	TOTAL
Puerto Rico	0	0	0	0	0
New England	0	0	0	0	0
Mid Atlantic	0	0	0	0	0
South Atlantic	0	0	0	1	1
East North Central	0	0	0	0	0
East South Central	0	0	0	0	0
West North Central	0	0	0	0	0
West South Central	1	0	0	0	1
Mountain	0	0	0	0	0
Pacific	0	0	1	0	1
TOTAL	1	0	1	1	3

Table 39-152
Ranking of Institutions That Are Likely To Begin Heart Transplantation With Medicare Coverage: Class O

CLASS BY REGION	LEVEL UNSPECIFIED
CLASS O	
Puerto Rico	2
New England	2
Mid Atlantic	6
South Atlantic	4
East North Central	8
East South Central	1
West North Central	8
West South Central	9
Mountain	2
Pacific	8
TOTAL	50

Table 39-153
Region By Class Classification For All Institutions That Are Likely To Begin Heart Transplantation With Medicare Coverage

	CLASS									
REGION	I	II	III	IV	V	VI	VII	VIII	O	TOTAL
Puerto Rico	0	0	0	0	0	0	0	0	2	2
New England	5	0	1	0	0	0	0	0	2	8
Mid Atlantic	5	0	5	0	4	0	0	0	6	20
South Atlantic	7	0	2	0	0	0	4	1	4	18
East North Central	8	0	3	0	3	0	5	0	8	27
East South Central	3	0	1	0	2	1	2	0	1	10
West North Central	4	0	0	1	4	0	2	0	8	19
West South Central	1	0	1	0	1	0	1	1	9	14
Mountain	4	0	2	0	1	0	0	0	2	9
Pacific	6	0	3	0	3	0	3	1	8	24
TOTAL	43	0	18	1	18	1	17	3	50	151

Medicare coverage of heart transplantation, an even larger number--170--said they are certain or likely to start a heart transplant program. Thus, based on our survey of 523 institutions with open-heart surgery facilities, we provide the estimates shown in Table 39-154. As shown here, within the next five years the U.S. could easily have in excess of 100 heart transplant programs, and quite possibly close to 200. We conclude, however, that it is extraordinarly difficult to estimate precisely the number of heart transplant programs that may emerge.

Using data assembled in various chapters of this report, it is possible to anticiapte some rather significant problems in meeting the need for heart transplantation. First, we have demonstrated that as many as 14,100 people could require a heart transplant in any given year. We argued, however, that many of these people would not qualify for a heart transplant because of a variety of contraindications. On the very low end we argued that perhaps as few as 1,932 of these 14,100 would actually be accepted for a heart transplant. Second, in estimating donor supply, we found that at the very outside there were 17,936 in-hospital deaths that could have given rise to an organ donor. Yet, based on prevailing attitudes, we estimate that only 9,506 organs may have been donated. Finally, based on the actual kidney donor pool in 1983, we estimate that, at the most, 866 hearts would be available over the course of a year, but perhaps as few as 325.

Based on these data, it is possible to estimate the number of heart transplant programs that may be required under varying assumptions.

Table 39-154
Number of Heart Transplant Programs Under Various Scenarios

PROGRAM STATUS	UNDER CURRENT CIRCUMSTANCES	IN NEXT FIVE YEARS	WITH MEDICARE COVERAGE
Currently Active Programs	20	20	20
Reactivated Programs	8	8	8
New Programs	74*	91	170**
TOTALS	102	119	198

*Assumes that every institution currently considering heart transplantation will initiate a program.

**Assumes that all those institutions that said they are likely to begin a program will do so.

If we assume that the optimal number of heart transplants performed per year by any one program is 21 (see above), then to meet the need for heart transplantation in the U.S., as many as 671 heart transplant programs would be required, or as few as 18 (see Table 39-155). With a substantial increase in the actual donor pool, perhaps at the very most 90-100 heart transplant programs would be required. Therefore, based on the results of our survey of open-heart surgery facilities, we estimate that, with Medicare coverage of heart transplantation, the number of heart transplant programs may be excessive, thus, constraining the number of procedures performed per year by any one center to a below optimal level.

Table 39-155
Number of Heart Transplant Centers Based On Varying
Estimates Of The Need For The Procedure And
The Supply Of Donors

BASIS FOR ESTIMATE	NUMBER OF CENTERS REQUIRED ASSUMING AN AVERAGE OF 21 TRANSPLANTS PER YEAR
All Persons In Need (14,100)	671
Low Estimate Of Persons Accepted (1,932)	92
High Donor Estimate (17,936)	671
Donor Estimate Based On Attitudes (9,506)	453
High Actual Donor Estimate (866)	42
Low Actual Donor Estimate (325)	16

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APPENDIX 39-A

MINIMUM UTILIZATION RATES REQUIRED FOR END-STAGE RENAL DISEASE TREATMENT FACILITIES

MINIMUM UTILIZATION RATES REQUIRED FOR ESRD FACILITIES

Facility Type	Facility Status: Unconditional Certification Requirements	Facility Status: Conditional Certification Requirements
Transplant center	15 or more transplants performed annually	7 to 14 transplants performed annually
Out-patient dialysis facilities[a]		
Urban[b]	6 or more dialysis stations, with an average of 4.5 or more dialyses per station a week	6 or more stations, with average of 4-4.5 dialysis per station a week
Rural[b]	3 or more stations, with average of 4 dialyses per station a week	2 stations, with average of 4 or more dialyses per station a week
In-patient dialysis facilities[a]	3 or more stations, with average of 4 or more dialyses per station a week	2 stations, with average of 4 dialyses per station a week

SOURCE: 41 Federal Register 22514-22515, June 3, 1976.

[a]Out-patient facilities are those performing more than 20 percent of their dialysis treatments on an out-patient basis; in-patient facilities are those performing 20 percent or fewer treatments on an out-patient basis.

[b]A facility is considred urban if it is located in an SMSA of 500,000 or more population; rural facilities are located in SMSAs of less than 500,000 or are not included in an SMSA.

APPENDIX 39-B

SURVEY OF OPEN-HEART SURGERY FACILITIES--1983

American
Hospital
Association

AHA

Survey of Open-Heart Surgery Facilities-1983

If you have any questions regarding
the content of this questionnaire or
the technical administration of this survey,
please call Larry Augustine at 312.280.6538
or Joseph D. Kubal at 312.280.6540.
Thank you for your participation.

American Hospital Association
Department of Survey Research
840 North Lake Shore Drive
Chicago, Illinois 60611

American Hospital Association

AHA

840 North Lake Shore Drive
Chicago, Illinois 60611
Telephone 312.280.6000
Cable Address AMHOSP

November, 1983

To: Chief Executive Officer

Subject: Survey of Open-Heart Surgery Facilities, 1983

The purpose of this brief survey is to determine the probable increase in the number of hospitals that will be performing heart transplantation over the next five years. The questionnaire specifically requests information about your hospital's plans and your department of surgery's plans on this important topic. This survey is being conducted by the Department of Survey Research of the American Hospital Association (AHA) in collaboration with Battelle Human Affairs Research Centers (HARC). It is only one phase of a larger effort, The National Heart Transplantation Study, that is being sponsored by the Health Care Financing Administration (HCFA).

This study will address numerous issues including: 1.) the need for heart transplantation in the U.S., 2.) the availability of donor hearts, 3.) the survival of heart transplant recipients, 4.) the cost of performing a heart transplant procedure and the routine care required thereafter, 5.) the quality of life and level of rehabilitation experienced by heart transplant recipients, and 6.) the legal and ethical issues surrounding heart transplantation. The major objective of the study, once the foregoing analyses are complete, is to examine the impact of a potential Medicare coverage decision on beneficiaries, the Medicare program, and health care providers.

Only hospitals with open-heart facilities, as listed on the American Hospital Association's Annual Survey, are being asked to participate. All responses to this survey will be strictly confidential. Data will be aggregated for reporting purposes and no individual hospital will be identified. We would appreciate your hospital's participation in this survey and we thank you for your aid in previous studies that we have conducted.

We suggest that this survey be routed to the chairman, chief, or director of your department of surgery for completion. If you have any questions regarding this survey, please call Larry Augustine at 312.280.6538 or Joseph D. Kubal at 312.280.6540 of the Department of Survey Research. If you have questions on the National Heart Transplantation Study, please contact Roger W. Evans, Ph.D. or Louis P. Garrison, Ph.D. at 206.525.3130 of the Battelle Human Affairs Research Centers.

Your hospital's participation in this survey is greatly appreciated.

Sincerely,

Ross Mullner, Ph.D.
Associate Director
Health Information and Data Services

Roger W. Evans, Ph.D.
Research Scientist
Project Director, National Heart Transplantation Study

SURVEY OF OPEN-HEART SURGERY FACILITIES-1983

1. Has your institution ever done heart transplants? *Card* *Pos*

[ ] Yes-1 (Please proceed to Question #10) [ ] No-2 *I* *08*

2. Is your institution currently considering the possibility of doing heart transplants?

[ ] Yes-1 (Please proceed to Question #6) [ ] No-2 *09*

3. In the past, has your institution considered doing heart transplants?

[ ] Yes-1 [ ] No-2 (Please proceed to Question #5) *10*

4. What were the major factors underlying the decision not to begin a heart transplant program?

11

5. Do you think that your institution will, in the near future, consider or reconsider the possibility of doing heart transplants?

[ ] Yes-1 [ ] No-2 *12*

6. Do you think that your institution will begin to do heart transplants within the next five years?

[ ] Yes-1 [ ] No-2 *13*

7. If heart transplantation were to become a Medicare-covered benefit, how would this affect the likelihood of your institution's doing heart transplants?

14

[ ] Make it a certainty -1
[ ] Increase the likelihood -2
[ ] Have no effect -3

8. Have any surgeons on your staff performed or assisted in doing a heart transplant?

[ ] Yes-1 [ ] No-2 *15*

9. What factors will determine whether or not your institution will perform heart transplants? (Please answer and proceed to Question #18)

_____ 16
_____
_____
_____
_____

10. How many heart transplants have been performed at your institution?

Total Number _____ 17-20

11. In what year was your first heart transplant performed at your institution?

Year 19_____ 21-22

12. In what year was the most recent heart transplant performed at your institution?

Year 19_____ 23-24

13. Is your current heart transplant program being conducted on a trial basis?

[ ] Yes-1 [ ] No-2 (Please proceed to Question #15) 25

14. What factors will determine whether or not your institution will continue to perform heart transplants?

_____ 26
_____
_____
_____
_____

15. How many heart transplants were performed at your institution during the past calendar year?

Number last year _____ 27-30

16. If heart transplantation were to become a Medicare-covered benefit, there is reason to think this could lead to an increased demand for the operation. Would you be willing to expand your program to accommodate this increase?

[ ] Yes-1 [ ] No-2 31

17. How many heart transplants would you like to see your institution perform each year?

Number per year _____ 32-35

18. Does your institution currently have the staff and facilities necessary to perform open-heart surgery?

[ ] Yes-1 [ ] No-2 36

19. In what year did your institution begin doing open-heart surgery?

Year 19_____ 37-38

20. Approximately how many of the following procedures were performed at your institution in 1982 (or in your most recent fiscal year)?

Procedure	Number	
a. Adult Open-heart Surgical Operations....	_____	39-42
b. Pediatric Open-heart Surgical Operations	_____	43-46
c. Kidney Transplants.....	_____	47-50
d. Cardiac Catheterizations.....	_____	51-54

21. How many (in full-time equivalents) of the following specialists are on your institution's staff?

Specialist	FTEs	
a. Anesthesiologists.....	_____	55-58
b. Cardiologists.....	_____	59-62
c. Cardiovascular Surgeons.....	_____	63-66
d. Immunologists.....	_____	67-70
e. Infectious Disease Specialists.....	_____	71-74
f. Neurologists.....	_____	75-78
g. Neurosurgeons.....	_____	2 08-11
h. Pathologists.....	_____	12-15
i. Transplant Surgeons (Kidney or other)....	_____	16-19
j. Virologists.....	_____	20-23

22. Does your institution have its own organ procurement program?

[ ] Yes-1 [ ] No-2 24

23. At your institution, in making a major policy decision such as whether or not to establish a heart transplant program, which of the following groups or persons must give their approval? (Please check all that apply)

[ ] Department of Surgery.....	01	25
[ ] Chief of Medical Staff.....	02	26
[ ] Hospital Administration.....	03	27
[ ] Board of Trustees.....	04	28
[ ] Other (Please specify)_____	05	29
[ ] Other (Please specify)_____	06	30

SURVEY OF OPEN-HEART SURGERY FACILITIES-1983
Executive Summary

PURPOSE:	To obtain an accurate estimate of the number of hospitals that will be involved in heart transplantation procedures throughout the next five years.
UNIVERSE:	All hospitals nationwide which have open-heart surgery facilities as listed by the American Hospital Association's Annual Survey. (N=641).
STATISTICAL TECHNIQUES:	Standard descriptive measures and summary statistics; (means, standard deviations, correlations, etc.).
DATA USE AND USE TO HOSPITALS:	This survey will aid in establishing baseline information on heart transplantation and its availability throughout the United States. Also, this information will be used to examine the impact of a potential Medicare coverage policy with respect to reimbursement for heart transplantation.
SPONSORSHIP AND FUNDING:	The Department of Survey Research of the American Hospital Association in collaboration with Battelle Human Affairs Research Centers and the Health Care Financing Administration.
RESULTS AVAILABLE TO:	Survey respondents, state and metropolitan hospital associations, and appropriate researchers in the health-care field. Also, on written request, to other registered hospitals.
ESTIMATED TIME TO COMPLETE:	Approximately one hour, depending upon the individual hospital's record-keeping system.
STAFF NEEDED TO COMPLETE:	Chairman, Chief, or Director of the Department of Surgery.

If we have any questions about your hospital's response to this questionnaire, whom shall we contact for further information?

NAME

TITLE

( )
TELEPHONE NUMBER

HOSPITAL

ADDRESS

CITY STATE ZIP CODE

THANK YOU for your participation in this study!

Please use the enclosed envelope to return the completed questionnaire to:

Department of Survey Research / 9-W
American Hospital Association
840 North Lake Shore Drive
Chicago, Illinois
60611

APPENDIX 39-C

STATES BY REGION IN THE UNITED STATES

STATES BY REGION

Puerto Rico

New England

Connecticut
Maine
Massachusetts
New Hampshire
Rhode Island
Vermont

Mid Atlantic

New Jersey
New York
Pennsylvania

South Atlantic

Delaware
District of Columbia
Florida
Georgia
Maryland
North Carolina
South Carolina
Virginia
West Virginia

East North Central

Illinois
Indiana
Michigan
Ohio
Wisconsin

STATES BY REGION (Continued)

East South Central

Alabama
Kentucky
Mississippi
Tennessee

West North Central

Iowa
Kansas
Minnesota
Missouri
Nebraska
North Dakota
South Dakota

West South Central

Arkansas
Louisiana
Oklahoma
Texas

Mountain

Arizona
Colorado
Idaho
New Mexico
Montana
Nevada
Utah
Wyoming

Pacific

Alaska
California
Hawaii
Oregon
Washington

CHAPTER 40

SOURCES OF PAYMENT FOR HEART TRANSPLANTATION WITH AN EMPHASIS ON THE ROLE OF PRIVATE INSURANCE

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A. INTRODUCTION

Over the past year both public and private insurers have demonstrated an intense interest in organ transplantation (Iglehart, 1983a; 1984). Since kidney transplantation is routinely covered by public and private insurers, the so-called "extrarenal" organ transplants--heart, heart-lung, liver, and pancreas--have been the primary focus of attention. The reason for concern has been the cost of these procedures. Many insurers have avoided paying for extrarenal transplants by arguing that they are experimental or investigational. The fear, of course, is that payment for such transplants will lead to increased premiums for policyholders.

While some private insurers have made remarkable attempts to estimate the cost of various extrarenal transplant procedures, others have refused payment on the basis of very limited data. Over the past year, however, some major private insurers have declared heart, heart-lung, and liver transplants therapeutic and have begun to pay for them. Such a decision by Blue Shield of California and Blue Cross and Blue Shield of Massachusetts has prompted many other insurance companies to review their policies. It should also be noted that each Blue Cross and Blue Shield organization acts independently with the national office in Chicago, simply coordinating the flow of information to each of the agencies located throughout the U.S. In other words, the national office does not make coverage decisions that are binding on other member agencies. Interestingly, however, many private insurers appear to look to the "Blues" for direction. In the past,

decisions by Blue Cross and Blue Shield of Massachusetts and Blue Shield of California have been precedent setting.

Private insurers, whether openly agreeing or not, also look to the Medicare program for guidance. If Medicare pays for a particular procedure, it is likely that private insurers will do so as well. The assumption made here is straightforward. Private insurers appear to trust the judgment of the administrators of the Medicare program when decisions must be made about new procedures and medical technology. Indeed, the Health Care Financing Administration (HCFA) with its administrative authority for the Medicare program has many resources upon which it can draw to make coverage determinations (what it will pay for) and reimbursement decisions (how much it will pay) (Iglehart, 1983b; Sun, 1983; Perry, 1982a; 1982b).

Organ transplants, however, have created a dilemma for both public and private insurers. Initially the private insurers looked to Medicare for guidance in deciding whether to pay for organ transplant procedures. Yet, Medicare (actually HCFA) was undecided on both heart and liver transplants pending the results of one extramural evaluation (the National Heart Transplantation Study) and one intramural study (on liver transplants being performed by the Office of Health Technology Assessment). The politics of the situation have been such that both HCFA and private insurers feel propelled to take action, but hesitate because a decision in favor of paying for extrarenal transplants would be based on very limited data (Iglehart, 1984). The Department of Health and Human Services (DHHS), of which HCFA is a part, has opted in favor of awaiting the results of the studies it has

sponsored or is carrying out. Private insurers, on the other hand, have moved more in the direction of making independent decisions. The fact that some private insurers have responded favorably has placed a burden on HCFA to respond in kind. Both DHHS and HCFA have been, and remain hestitant. As the evidence upon which they must make a decision accumulates, a decision is likely to be forthcoming. For example, in testimony before a House Ways and Means health subcommittee hearing on February 9, 1984, Department of Health and Human Services Assistant Secretary for Health, Dr. Edward Brandt, declared that liver transplantation was non-experimental for children with "...biliary atresia and other rare congenital abnormalities," but noted that "...additional clinical trials should be conducted for other conditions leading to end-stage liver disease."

The primary objective of this chapter is threefold. First, results from the National Medical Care Expenditures Survey (NMCES) will be presented to characterize the extent to which the U.S. population is covered by private health insurance. Characteristics of the non-insured population are also presented. Second, the results of a 1983 survey conducted by the Health Insurance Association of America regarding "Reimbursement Practices for Experimental Procedures and Organ Transplants Under Group Major Medical Expense Plans" are discussed. Finally, data on insurance coverage as reported by the living heart transplant recipients in the National Heart Transplantation Study are presented. Taken together, the data presented here provide a very good overview of not only how private insurers have said they would respond to reimbursement requests for

extrarenal organ transplant procedures (the HIAA survey), but also how they have actually responded in the past (the National Heart Transplantation Study results). By looking at the characteristics of the proportion of the population without some form of private insurance coverage (e.g., people who are of an acceptable age for a heart transplant are slightly less likely to have private insurance than those who are beyond the age for which a heart transplant is acceptable) it is possible to gain some understanding of what the public insurance responsibilities are likely to be for organ transplantation if private insurers are willing to reimburse for extrarenal transplants, and the government does not embark on a broad-based entitlement program.

B. EXTENT OF PRIVATE INSURANCE COVERAGE IN THE U.S.

In 1977, based on data collected as part of the National Medical Care Expenditures Survey (NMCES), it was estimated that 79.4 percent of the U.S. population was covered by private health insurance. Of those persons covered, the vast majority, 82.4 percent, had group coverage, 14.2 percent held individual coverage, and the remainder (3.4 percent) were insured under both group and individual policies (Cafferata, 1983). As shown in Table 40-1, coverage varied according to various sociodemographic characteristics. For example, only 68.2 percent of those persons age 65 and older had private insurance coverage while nearly 85 percent of those ages 55 to 64 did. Least likely to be covered by private insurance were persons less than 6 years of age (74.4 percent). Nearly 80 percent of both males and

Table 40-1: Private health insurance of the U.S. population: percent of persons with private health insurance coverage and percent distribution of type of contract, by selected population characteristics, United States, 1977.

Population Characteristics	Population	Covered by Private Health Insurance
	Thousands	Percent
Total*	212,117	79.4
Ages in years		
Less than 6	18,007	74.4
6 to 18	50,911	78.2
19 to 24	22,209	76.9
25 to 54	78,507	83.9
55 to 64	20,204	84.8
65 or older	22,280	68.2
Sex		
Male	102,612	80.4
Female	109,506	78.5
Household size		
Single person	19,986	70.9
Family	192,131	80.3
Ethnic/racial background		
White	158,632	84.9
Black	21,337	60.3
Hispanic	9,597	62.5
Income adjusted for family size		
Poor and near poor	31,282	41.0
Other low income	32,360	71.3
Middle income	81,775	86.6
High income	66,700	92.6
Occupation of family head		
Farm	5,413	78.7
Blue collar	69,633	87.0
Service	19,501	75.7
White collar	67,592	88.6
Not employed in 1977	29,798	44.3
Place of residence		
SMSA	145,080	80.4
Other	67,038	77.4
U.S. Census region		
Northeast	45,212	84.1
North Central	61,640	86.8
South	66,944	74.1
West	38,321	71.4

[a]Includes all other ethnic/racial groups not shown separately and persons in families whose head had unknown occupation or employment status.

[b]Relative standard error equal to or greater than 30 percent.

Source: Cafferata, 1983.

females had private insurance. Blacks and Hispanics were much less likely to have private insurance than whites. Lower income households were much less likely than high income families to have private health insurance. Only 44.3 percent of those persons unemployed in 1977 had private insurance coverage. Finally, there was some regional variation in the proportion of persons covered: 71.4 percent of the people in the West had private insurance while 86.8 percent of those in the North Central did.

As shown in Table 40-2, when persons with Medicare coverage are removed from Table 40-1, the percentage distributions are altered only slightly. For example, 81.3 percent of the non-Medicare eligible people in the population are covered by private insurance. Of these, 87.7 percent have group contracts, 9.3 percent nongroup contracts, and 3.0 percent have group and nongroup contracts.

Kasper and coworkers (1979) have completed a detailed analysis of uninsured persons based on the first household interview in the National Medical Care Expenditures Survey. In their analysis they estimated that 12.6 percent of the people in the U.S. population were without health insurance. They also present data on selected characteristics of uninsured persons who belonged to families with one or more insured members or to families entirely without coverage, or who lived alone or in households unrelated to them. These results are shown in Table 40-3. Since various combinations of health insurance existed in some families, types of coverage in the families of the uninsured are shown in Table 40-3 as follows:

Table 40-2: Private health insurance of the U.S., population not on Medicare: Percent of persons[a] with private health insurance coverage and percent distribution by type of contract, United States, 1977.

Population Characteristics	Population	Covered by Private Health Insurance
	Thousands	Percent
Total*	187,264	81.3
Ages in years		
Less than 6	17,931	74.6
6 to 18	50,678	78.5
19 to 24	22,096	77.1
25 to 54	77,221	84.5
55 to 64	18,813	87.0
65 or older	524	68.8
Sex		
Male	92,033	82.0
Female	95,231	80.6
Household size		
Single person	12,509	74.8
Family	174,755	81.7
Ethnic/racial background		
White	139,700	86.4
Black	19,225	63.4
Hispanic	9,036	65.3
Income adjusted for family size		
Poor and near poor	24,906	40.4
Other low income	26,711	73.0
Middle income	74,121	87.7
High income	61,526	93.6
Occupation of family head		
Farm	5,040	78.7
Blue collar	66,538	87.2
Service	17,359	75.3
White collar	64,339	89.0
Not employed in 1977	16,164	36.2
Place of residence		
SMSA	128,804	82.2
Other	58,461	79.1
U.S. Census region		
Northeast	39,410	86.0
North Central	55,244	88.2
South	59,037	76.5
West	33,574	72.7

[a]Includes all other ethnic/racial groups not shown separately and persons in families whose head had unknown occupation or employment status.

[b]Relative standard error equal to or greater than 30 percent.

Source: Cafferata, 1983.

Table 40-3: Uninsured persons, family setting, and insurance coverage of other family members: Percent distribution by type of coverage for selected characteristics. (NMCES: United States, 1977. First household interview)

Population Characteristics	Population-in Thousands	Total	Type of coverage in families of uninsured persons						
			Medicare only or with private or other insurance (Type 1)	Medicaid only or with private or other insurance (Type 2)	Both Medicare and Medicaid or both with private or other insurance (Type 3)	Private Insurance only or private with insurance excluding Medicare and Medicaid (Type 4)	Other Public insurance only (Type 5)	No Insurance (Type 6)	Unrelated Individuals without insurance[a]
			Percent distribution						
All persons	26,560	100.0	7.2	5.9	2.3	28.1	1.0*	43.2	12.2
Age									
Less than 6	2,275	100.0	4.1*	6.2	1.0*	28.2	2.0*	57.7	0.7*
6-17 years	5,810	100.0	7.1	5.7	3.3	27.3	0.7*	54.6	1.3*
18-24 years	5,836	100.0	4.2	6.7	1.6*	35.2	1.2*	30.9	20.2
25-54 years	9,436	100.0	6.6	5.6	2.0	25.4	1.0*	45.8	13.6
55-64 years	2,248	100.0	17.2	5.6	4.8	23.7	0.5*	29.6	18.6
65 or older	955	100.0	16.3	4.8*	0.7*	26.6	0.5*	22.8	28.2
Sex									
Male	13,419	100.0	7.2	6.0	2.3	28.5	1.0*	41.7	13.2
Female	13,141	100.0	7.2	5.7	2.3	27.7	1.0*	44.9	11.1
Color									
White	21,472	100.0	7.4	4.4	1.6	28.6	0.8	44.7	12.6
All other	5,088	100.0	6.5	12.1	5.4	26.2	1.9*	37.2	10.8

[a]Most unrelated individuals surveyed lived alone. Those who lived with persons to whom they were not related were interviewed separately and are treated as a separate single household in these estimates.

*Relative standard error equal to or greater than 30 percent.

Source: Kasper et al., 1979.

- Type 1: Medicare coverage only or Medicare combined with some other insurance (excluding Medicaid).
- Type 2: Medicaid coverage only or Medicaid combined with some other insurance (excluding Medicare).
- Type 3: Both Medicare and Medicaid coverage or both with some other insurance.
- Type 4: Private insurance only or private insurance combined with other insurance (excluding Medicare and Medicaid).
- Type 5: Public insurance only (e.g., CHAMPUS), other than Medicare and Medicaid.
- Type 6: No insurance coverage.

As shown in Table 40-3, among all uninsured persons, 28.1 percent were members of Type 4 families; 43.2 percent belonged to families without any coverage; and 12.2 percent lived alone or in unrelated households (Kasper et al., 1979:4). Differences in the distribution of uninsured persons according to age indicate that more than half of those in the age groups below 17 years of age were likely to be in families without any insurance coverage (Type 6), and the uninsured in the 18 to 24 year age group were more likely than others to belong to families where at least one member was covered by private insurance (Type 4). Those uninsured in the 55 to 64 age group were more likely than others to be members of families where at least one member was covered by Medicare (22 percent, Types 1 and 3).

In a more recent publication, the Health Insurance Association of America (HIAA) estimates that at the end of 1981, more than 188 million Americans or 84 percent of the civilian noninstitutionalized

population were covered by one or more forms of private health insurance (HIAA, 1984). The HIAA estimates that these included nearly 173 million persons under age 65, thus revealing that 86 percent of those persons 65 years of age and older held private health insurance policies to supplement benefits available through Medicare.

The HIAA report also contains data on the uninsured population that are not unlike those presented above. For example, the report notes that the Social Security Administration estimated that, in 1976, 12 to 13 percent of the U.S. population under age 65 had no public or private protection against the cost of hospital or surgical care. In 1974, the HIAA report notes that only 6 percent of the total population was without private or public health insurance. Finally, the HIAA report cites the Congressional Budget Office's (CBO) most recent report on the uninsured population which concluded that between 5.0 and 8.0 percent of the population was without health care coverage in 1978. According to the CBO report, young adults were almost twice as likely as any other age group to be without coverage and, although they accounted for 11.0 percent of the population, they represented over 20.0 percent of the uncovered population.

Based on the foregoing, it is apparent that the vast majority of the population has some form of private insurance coverage, but the estimate of the percent of the population without such coverage is 5.0 to 12.0 percent. The question to be addressed here, however, is what proportion of private insurance companies include coverage for heart transplantation? Private insurers appear to differ considerably in their approach to heart transplantation. Many have ruled the

procedure to be experimental or investigational while others have proceeded with decisions to reimburse not only for heart transplants, but also heart-lung transplants.

C. THE HEALTH INSURANCE ASSOCIATION OF AMERICA SURVEY

In June, 1983, the Health Insurance Association of America (HIAA) mailed a questionnaire on reimbursement practices for experimental procedures and organ transplants under group major medical expense plans to 40 of the leading insurance company writers of group health insurance (HIAA, 1983). Replies were received from 33 companies. The companies that responded to the survey accounted for 57 percent of the group health insurance premiums written by companies in the United States in 1982 (HIAA, 1983). What follows is a near verbatim report of the HIAA survey results.

Of the 33 companies that responded to the HIAA survey, 19 reported that under certain conditions experimental procedures would be covered. In the absence of a specific exclusion in the contract for experimental treatment, the HIAA (1983) reports that the following factors are considered in paying for benefits when the procedure used is of an experimental nature:

- Meeting the tests of the contract regarding medical necessity and appropriateness.
- All conventional methods of treatment have been unsuccessfully tried and the patient's condition is life threatening.
- Life is in the balance and the claimant is legally required to pay for the procedure.

- The medical profession is of the opinion that the procedure may be beneficial. Also, when the procedure is not controversial; is generally perceived as favorable; and the AMA has not adopted a negative position.

- The policyholder has requested coverage of such a procedure.

The HIAA also reported several reasons for not covering an experimental procedure including:

- The procedure is specifically excluded in some contracts.

- The procedure has not been proven to be safe and effective.

- The procedure is not consistent with currently accepted medical practice.

- "Usual and customary" language would normally be the basis for exclusion.

- No sufficient information is available as to the procedure's relief of the symptoms or its success rate, or the risks associated with its use.

Based on these findings, the HIAA concluded that the basis for determining whether a particular procedure is experimental or not varies among the companies. In the main, however, the HIAA (1983) noted, "...the sources from which the needed information is obtained include the Medical Procedures Appropriateness Program of the HIAA and Council of Medical Specialty Societies, state or national medical societies, government agency assessment reports, and articles in medical journals." According to the HIAA, one company responding to its survey reported "...that the question of whether a procedure is experimental is irrelevant to its standard policy wording. The

tests of medical necessity/appropriateness are used as criteria for coverage."

In previous correspondence with the HIAA, Mr. Andrew Korsak (Chicago) has provided information on the HIAA review process for new medical procedures and health care technologies. The following statement was forwarded for inclusion in the final report of the National Heart Transplantation Study:

> The HIAA furnishes information on medical procedure appropriateness by reporting opinions rendered by the Council of Medical Specialty Societies' (CMSS) Program for Clinical Procedure Review. In late 1977, the CMSS agreed to be the focal point for questions raised by all insurers (not only Blue Shield Plans) requiring evaluation of possibly outdated and unnecessary procedures. Because of the impracticality of having several hundred insurers contact CMSS directly, it was agreed that the HIAA would serve as the intermediary between the CMSS and the insurance industry. In this role HIAA has been a funnel to the CMSS Health Care Delivery Committee for medical and surgical procedural questions from HIAA member companies. HIAA also has served as a conduit of specific information, namely professional determinations on medical appropriateness of referred procedures made by the CMSS Member Specialty Societies then channeled through the CMSS Health Care Delivery Committee, back to the HIAA companies through releases to the commercial health insurance industry published by HIAA.

Thus, the HIAA does have a method that is generally applied to assess health care technologies. This review process could certainly be applied to extrarenal organ transplant procedures but the results of such a review process, if it has been undertaken, have not, as of this time, been made available to us.

The results of the HIAA survey on organ transplantation as one particular technology are quite revealing. Again, of the 40 companies

the HIAA surveyed, 33 responded to their questionnaire. The questionnaire elicited information on company practices in reimbursing expenses of a recipient for four types of transplants. The results of the HIAA survey are contained in Table 40-4. As shown here, all 33 companies paid for kidney transplants, 32 for bone marrow transplants, 28 for heart transplants, and 27 for liver transplants. The HIAA research summary also indicates that other types of transplants were reportedly covered including corneas, pancreata, bone homografts, and skin grafts.

In addition, the companies included in the HIAA survey were asked whether they follow the recommendations in the HIAA Statement on Human Organ or Tissue Transplants approved by the HIAA Board in 1972 (see Appendix 40-A). Thirty of the 33 companies responded affirmatively. The other 3 companies indicated that the difference between their practice and that recommended in the Statement was that the unpaid portion of the donor's expenses may not be covered under their plans which insure the recipient.

D. THE PRIVATE INSURANCE EXPERIENCE IN THE NATIONAL HEART TRANSPLANTATION STUDY

As noted in the introduction to this chapter, considerable data on sources of payment were collected from living heart transplant recipients. At the outset of the study it was assumed that there was relatively little support for heart transplantation on behalf of private insurers. Data were unavailable to ascertain their level of commitment. It was expected, however, that there would be more than a single source of payment for a procedure thought to be as expensive

Table 40-4
Results of the HIAA Survey on Organ Transplantation

TRANSPLANT PROCEDURE	NUMBER AND PERCENT OF COMPANIES			
	YES		NO	
	Number	Percent	Number	Percent
Kidney Transplants	33	100.0	0	0.0
Bone Marrow Transplants	32	96.9	1	3.1
Heart Transplants	28*	82.1	5	17.9
Liver Transplants	27*	77.8	6	22.2

*Includes companies which have not yet taken a definite position, but probably will pay under certain conditions.

as a heart transplant. It was also evident that private insurers did not necessarily respond uniformly in their reimbursement practices. In particular, some insurers ruled that heart transplantation was experimental but were willing to reimburse for hospital expenses that were not directly related to heart transplantation per se. For example, a claim may be reviewed and the patient reimbursed for all expenses considered to be not specifically required for the transplant. In such instances, the insurer assumes that the patient would have been hospitalized anyway and, thus, for example, the room charges would be reimbursed. But, in the case of a heart transplant, a procedure such as an endomyocardial biopsy would not be covered since this would be considered a purely transplant-related expense.

To properly map all sources of payment for heart transplantation, in the National Heart Transplantation Study we divided the entire transplant experience into three periods. They were: (1) the period while the patient was awaiting transplantation, (2) the period during which the heart transplant operation was performed, and (3) the posttransplant period. We asked each living heart transplant recipient to indicate which of the following sources of payment paid their medical expenses associated with each of the foregoing periods:

- out-of-pocket
- private insurance
- Medicare
- Medicaid (or Medi-Cal)

- transplant center
- direct donations
- other

Patients were asked to specify the source if "other" was indicated. Based on this, two other sources of payment were added to our list. They were: the CHAMPUS program and the Veteran's Administration.

Once patients had answered the questions concerning all sources of payment, they were then asked to indicate the primary source of payment for those expenses associated with each of the three periods identified above. There could, of course, only be one primary source of payment.

1. ALL SOURCES OF PAYMENT

Tables 40-5 through 40-7 present the results of our survey with regard to all sources of payment. As revealed in these tables, a large proportion of patients received assistance from private insurers during all three periods. The results are as follows: 71.7 percent while patients awaited transplantation, 66.4 percent during the period the patient was transplanted, and 73.7 percent during the posttransplant period. It is also evident from Tables 40-5 through 40-7 that payment sources varied from period to period. For example, patients were less likely (40.8 percent) to incur out-of-pocket expenses during the transplant period, while over two-thirds (68.4 percent) did so during the posttransplant period. Medicare was more likely to reimburse for patient expenses during the posttransplant period than any other period. Medicaid was clearly not a source of payment for a very large percentage of patients with only 9.2 percent

Table 40-5
Sources of Payment for Medical Expenses While Patients
Were Awaiting Heart Transplantation

SOURCE OF PAYMENT	PERCENT OF PATIENTS INDICATING "YES" FOR EACH SOURCE*
OUT-OF-POCKET	67.8
PRIVATE INSURANCE	71.7
MEDICARE	15.1
MEDICAID	5.9
TRANSPLANT CENTER	19.7
DIRECT DONATIONS	27.0
CHAMPUS PROGRAM	.7
VETERAN'S ADMINISTRATION	7.2
OTHER	7.9

*Percentage total exceeds 100 percent since patients may have had more than one source of payment.

Table 40-6
Sources of Payment for Medical Expenses Associated
With The Heart Transplant Operation

SOURCE OF PAYMENT	PERCENT OF PATIENTS INDICATING "YES" FOR EACH SOURCE*
OUT-OF-POCKET	40.8
PRIVATE INSURANCE	66.4
MEDICARE	14.5
MEDICAID	5.3
TRANSPLANT CENTER	53.3
DIRECT DONATIONS	16.4
CHAMPUS PROGRAM	.7
VETERAN'S ADMINISTRATION	3.9
OTHER	3.3

*Percentage total exceeds 100 percent since patients may have had more than one source of payment.

Table 40-7
Sources of Payment for Medical Expenses Posttransplant

SOURCE OF PAYMENT	PERCENT OF PATIENTS INDICATING "YES" FOR EACH SOURCE*
OUT-OF-POCKET	68.4
PRIVATE INSURANCE	73.7
MEDICARE	32.3
MEDICAID	9.2
TRANSPLANT CENTER	40.8
DIRECT DONATIONS	12.5
CHAMPUS PROGRAM	.7
VETERAN'S ADMINISTRATION	5.9
OTHER	4.6

*Percentage total exceeds 100 percent since patients may have had more than one source of payment.

of the patients indicating that Medicaid assisted them with post-transplant expenses. Transplant center funds, largely owing to Stanford University Medical Center's grant from the National Institutes of Health, were most likely to be a source of payment during the transplant period. Direct donations were a primary source of payment during the pretransplant period. Neither the CHAMPUS nor VA programs were major sources of payment for any of the periods.

A word of caution is warranted in reviewing the foregoing results. As is well-known, Medicare does not currently reimburse for heart transplantation, nor do most state Medicaid programs. It should be recalled, however, that for a brief period of time Medicare did pay for heart transplants at Stanford University Medical Center. Likewise, some Medicaid programs have paid for heart transplants. Thus, it should come as no surprise that heart transplant recipients have indicated support from both of these programs.

2. PRIMARY SOURCE OF PAYMENT

As noted above, patients were also asked about their primary source of payment. Tables 40-8 through 40-10 summarize the pertinent results for the pretransplant, transplant, and posttransplant periods. As shown in these tables, what is most noteworthy is the involvement of private insurers. During the pretransplant period, 61.2 percent of the patients indicated that private insurance was their primary source of payment, while 54.6 percent did so for the transplant period, and 53.3 during the posttransplant period.

Table 40-11 summarizes the results for the three periods according to the three major primary sources of payment. Not

Table 40-8
Primary Source of Payment for Medical Expenses While Patients Were Awaiting Heart Transplantation

SOURCE OF PAYMENT	PERCENT OF PATIENTS INDICATING "YES" FOR EACH SOURCE*
OUT-OF-POCKET	6.6
PRIVATE INSURANCE	61.2
MEDICARE	6.6
MEDICAID	3.9
TRANSPLANT CENTER	6.6
DIRECT DONATIONS	3.9
CHAMPUS OR VA	5.9
OTHER	.7
DON"T KNOW/REFUSED	4.6

*Percentage total may not equal 100 percent due to rounding error.

Table 40-9
Primary Source of Payment for Medical Expenses Associated
With The Heart Transplant Operation

SOURCE OF PAYMENT	PERCENT OF PATIENTS INDICATING "YES" FOR EACH SOURCE*
OUT-OF-POCKET	.7
PRIVATE INSURANCE	54.6
MEDICARE	1.3
MEDICAID	1.3
TRANSPLANT CENTER	29.6
DIRECT DONATIONS	2.6
CHAMPUS OR VA	3.3
OTHER	.7
DON"T KNOW/REFUSED	6.0

*Percentage total may not equal 100 percent due to rounding error.

Table 40-10
Primary Source of Payment for Medical Expenses Posttransplant

SOURCE OF PAYMENT	PERCENT OF PATIENTS INDICATING "YES" FOR EACH SOURCE*
OUT-OF-POCKET	2.0
PRIVATE INSURANCE	53.3
MEDICARE	12.5
MEDICAID	3.3
TRANSPLANT CENTER	14.5
DIRECT DONATIONS	2.6
CHAMPUS OR VA	6.6
OTHER	.7
DON"T KNOW/REFUSED	4.6

*Percentage total may not equal 100 percent due to rounding error.

Table 40-11
Three Leading Primary Sources of Payment By Transplant Period

	PERIOD		
SOURCE OF PAYMENT	PRETRANSPLANT	TRANSPLANT	POSTTRANSPLANT
Out-of-Pocket	6.6	--	--
Private Insurance	61.2	54.6	53.3
Medicare	6.6	--	12.5
Medicaid	--	--	--
Transplant Center	6.6	29.6	14.5
Direct Donations	--	--	--
CHAMPUS or VA	5.9	3.3	--
Other	--	--	--
Don't Know/Refused	--	--	--

surprisingly, as shown in this table, Medicare was a primary source of payment only during the pretransplant and posttransplant periods. Also, again largely attributable to Stanford's NIH grant, transplant center funds were a major source of payment during the transplant period. Finally, out-of-pocket funds were used as a primary source of payment only during the pretransplant period.

3. THE ACQUISITION AND LOSS OF PRIVATE INSURANCE COVERAGE

When asked if private insurance covered any of their expenses since they were declared a candidate for a heart transplant, 81.6 percent of the living heart transplant recipients responded affirmatively. As revealed above in Tables 40-5 through 40-7, there was some variation in the percentage of patients who indicated private insurers helped them pay their bills according to time period.

In the survey, transplant patients were also asked if they had lost private insurance since the time they first became a heart transplant candidate. The results showed that 18.4 percent of the patients we interviewed had lost coverage. The reasons patients lost coverage are shown in Table 40-12. Of the 28 patients who have lost private insurance coverage, 10 did so because they or their spouse lost a job or are unemployed. Four patients indicated that they lost their coverage because they were viewed as high risk patients.

At the time of the survey, 69.7 percent of the patients indicated that they still have private insurance coverage. This is down from the 81.6 percent of the patients who indicated that private insurers had at some point aided them in the payment of their medical expenses.

Table 40-12
Reasons Heart Transplant Recipients Have Lost
Private Insurance Coverage

REASONS FOR LOSS OF COVERAGE	NUMBER OF PATIENTS
Lost job or unemployed	10
Divorce	1
Used maximum benefits	2
Became eligible for Medicare	3
High risk	4
Refused payment after transplant	1
Company went bankrupt	2
Employer went to self-insurance	1
Expired and nonrenewable policy	2
Insurance company reduced coverage	1
Other	1

Twenty patients in the study indicated that they are still trying to obtain additional private insurance. Fifty-four patients or 35.5 percent of the patients feel they have been denied private insurance because they are a heart transplant recipient. Given the fact that some insurance companies consider transplant recipients as high risk beneficiaries, this may not be as surprising as it first appears.

E. CONCLUSION

The intent of this chapter has been to provide insight into the manner in which private insurers have dealt with heart transplantation. The chapter began by pointing out that 79.4 percent of the U.S. population is covered by private insurance. If current Medicare beneficiaries are excluded from consideration, 81.3 percent of the population is covered by private insurance, most frequently under group policies.

The results of a June, 1983 survey conducted by the Health Insurance Association of America revealed that 82.1 percent of the nation's top commercial health insurance companies are willing to pay for heart transplants under their group major medical expense plans, although many companies indicated that payment "may depend on whether certain criteria are met."

Finally, results from the National Heart Transplantation Study survey of living heart transplant recipients indicates that 71.7 percent of the patients received private insurance assistance for pretransplant expenses, 66.4 percent for transplant expenses, and 73.7

percent for posttransplant expenses. Private insurance was not necessarily the primary source of payment for heart transplant-related expenses. Of the living transplant recipients, 61.2 percent said private insurance was the primary source of payment for pretransplant expenses, 54.6 percent for transplant expenses, and 53.3 percent for post-transplant expenses.

Based on the results presented in this chapter, it is evident that private insurers have made a substantial commitment to heart transplantation, although not all companies have a formal policy that entails payment for heart transplants. Without question, a general trend has been observed in the direction of private insurance coverage for heart transplants as a nonexperimental therapy. Several major health insurers have announced plans to cover heart transplantation. The fact that the results of the HIAA survey are slightly inconsistent with those of the National Heart Transplantation Study survey confirms this trend. It is likely this trend will continue unless the results of heart transplantation diminish or the cost projections of private insurers for heart transplantation are exceeded. In effect, private insurers could change their policies disallowing coverage for heart transplantation.

It is possible to speculate on the potential impact private insurance coverage would have on the number of persons public insurers may be responsible for covering if a favorable coverage determination is issued by the Health Care Financing Administration. In the absence of the promulgation of a full entitlement program, public insurers, that is, the Medicare and Medicaid programs are likely to be

responsible for covering a small number of cases. A full entitlement program, of course, would bring with it a much more substantial commitment as did end-stage renal disease when Medicare benefits were extended to patients with chronic renal failure. Without a full entitlement program, public insurers would appear to be responsible for between 20-30 percent of all heart transplants, assuming that all persons in need of a heart transplant would eventually receive one.

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APPENDIX 40-A

HIAA STATEMENT
RE: HUMAN ORGAN OR TISSUE TRANSPLANTS

EXHIBIT A

HIAA STATEMENT
RE: HUMAN ORGAN OR TISSUE TRANSPLANTS

(Approved by the Board of Directors of the Association
February 25, 1972)

Recent advances in medicine have resulted in an increasing number of human organ or tissue transplants. This development has posed questions as to the responsibility of the various insurers involved with respect to expenses incurred in securing the organ or tissue, particularly when it is secured from a living donor.

The Health Insurance Association of America endorses the principle that the donation by a live donor of a healthy organ or tissue should be considered as a valid "non-occupational disease or disability" of the donor and strongly urges insurers to adopt this principle in designing future and revising existing health care expense contracts and disability income contracts.

In addition, the Health Insurance Association of America recommends the following:

A. When Organ or Tissue is Secured from a Cadaver Either Directly or Through a Bank

That the insurer of the recipient consider the reasonable cost of securing such organ or tissue as if it were a valid hospital ancillary service charge and pay its policy benefits with respect thereto.

Note: The reasonable cost will normally include a surgeon's charge for removing the organ or tissue from the cadaver, a hospital's charge for the operating room and supplies used in connection therewith, together with a charge by the agency responsible for storing the organ or tissue and transporting it to the hospital where it is implanted in the recipient. The public should be advised that it is impractical to assess this type of expense to the donor because of the fact that the donor's insurance will have ceased at death. In addition, insurers should encourage the establishment of organ or tissue banks which could make one single charge for furnishing the desired organ or tissue, the amount of charge varying by the particular organ or tissue involved.

B. When Organ or Tissue is Secured from a Living Donor

That the insurer of the recipient adopt or expand the practice of reimbursing any unpaid medical expenses of a live donor to the extent that benefits remain and are available under the recipient's plan after benefits for the recipient's own expense have been paid.

****

Released by: Health Insurance Association of America
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FOR IMMEDIATE RELEASE

SURVEY SHOWS MOST COMMERCIAL HEALTH INSURERS WILLING TO PAY FOR ORGAN TRANSPLANTS

Washington, D.C. Aug. 10 -- More than three-fourths of the nation's top commercial health insurance companies are willing to pay for liver or heart transplants under their group major medical expense plans, according to an informal survey released today by the Health Insurance Association of America (HIAA).

Further, nearly all companies responding to the survey said they are reimbursing for kidney, bone marrow, cornea and pancreas transplants.

The survey compiled responses from more than 30 of the nation's largest writers of group health insurance, representing nearly 60 percent of the business. It also sheds light on how a company makes the decision to begin paying for a procedure that was previously considered uncovered.

"This survey documents the industry's efforts to expand health insurance coverage as the medical state-of-the-art is advanced," said James L. Moorefield, HIAA president. "As today's experimental procedures become widely accepted by medical professionals, we have evidence that insurers are taking the lead in providing necessary financial protection."

According to the survey, 82 percent of the companies said they are willing to pay for liver transplants, although payment may be based on certain conditions. Eighteen percent said they will not reimburse for a liver transplant.

In addition, 85 percent said they are willing to pay for heart transplants. As with liver transplants, however, many said payment may depend on whether certain criteria are met. Fifteen percent said they will not reimburse for heart transplants.

Virtually all companies said they will pay for kidney and bone marrow transplants.

What criteria do companies consider when deciding whether to reimburse for an organ transplant? Although specifics vary from company to company, the survey shows that some questions asked by an insurer might include:

- Is the procedure medically necessary?
- Have all other conventional methods of treatment been tried?
- Is the patient's condition life threatening?

In addition, insurers said they check the policyholder's contract to make sure the condition is not specifically excluded.

When first making the decision to begin reimbursements for a new medical procedure, companies said they rely heavily on information from the medical profession on the safety and effectiveness of the procedure.

The survey shows that specialty medical associations, state or national medical societies, new research studies, articles in medical journals and government reports are among the sources companies look toward for information. If, for example, the procedure is controversial or not proven safe and effective, a company may decide against reimbursement, according to the survey.

The survey, taken in June, attempts to answer questions about how the commercial health insurance industry has responded to new medical trends.

"The survey reassures us that companies do not make reimbursement decisions lightly, nor do they drag their feet in light of new medical evidence," said Mr. Moorefield. "It also reaffirms our belief that individuals needing medical treatment should get it and then return to their normal activities as quickly as possible."

CHAPTER 41

AN EXCURSION INTO THE FIELD OF HEALTH CARE TECHNOLOGY ASSESSMENT

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A. INTRODUCTION

As of late, health care technology assessment has attracted considerable attention on Capitol Hill. It is no small wonder, as many have argued that rising health care costs are largely attributable to both large (e.g., CAT scanners, organ transplant procedures) and small (e.g., overuse of laboratory tests) medical technology (Altman and Blendon, 1979; Moloney and Rogers, 1979; Blendon and Moloney, 1979; Jennett, 1984; Anonymous, 1984; Editorial, 1983). To curb both the use and abuse of medical technology, legislation has been introduced in Congress (Fox, 1984) to provide a mechanism by which periodic assessments can be undertaken through either a private sector organization (Senate Bill S-2504, Senator Quayle) or a government supported activity (House Bill HR-5496, Congressman Waxman). As it now stands, Senator Quayle's bill would create a private, nonprofit institute comprised of representatives from research, industry, insurer groups, health care providers, consumers and the federal government to assess medical technologies and promote or discourage the use of technologies based on those evaluations. The bill would authorize $2.0 million to support the institute over seven years. Department of Health and Human Services Assistant Secretary for Health, Dr. Edward Brandt has expressed skepticism over this proposal (Brandt, 1984). However, the bill introduced by Congressman Waxman and Madigan has received the support of the Assistant Secretary. This bill represents a more general approach to technology assessment that, in Brandt's words, "emphasizes the role" of the National Center for Health Services Research. Other

suggestions have also been offered for the assessment of technology (Bunker et al., 1982a; 1982b; Sammons, 1983; Jones, 1983; Perry, 1982a; 1982b; Barclay, 1978; Relman, 1982; Perry and Kalberer, 1980; Frederickson, 1978; Sun, 1983). For example, it has been argued in testimony before Congress, that the Institute of Medicine (IOM) should take a more active role in the assessment of health care technology. A single solution to the apparent problem of medical technology assessment is yet to emerge (Brandt, 1984).

At first blush it seems unusual that legislators and policymakers have been preoccupied for the past year with organ transplantation and health care technology issues (Gore, 1983; Waxman, 1983). In many respects the two issues, although related, seem contradictory. Upon close examination, however, the association between the two is obvious. Thus, it is not unusual to find that the same Congressmen introducing bills in support of organ transplantation are also doing so for health care technology assessment. For example, on the one hand, some legislators have been very supportive of new legislation pertaining to organ transplants, yet, on the other hand, they have also introduced other legislation that seems to call into question their stand on organ transplantation. The dilemma this creates is by no means simple. While political expediency may in part dictate their actions, it is quite possible that the complications associated with organ transplantation issues have clearly forced legislators to take a longer term perspective on new health care technologies. Thus, perhaps, the recent focus on health care technology assessment is an

expression of the uneasiness many congressmen and their aides have experienced as they have confronted the organ transplant issue.

It is not the purpose of this chapter to take a definite position on the issue of health care technology assessment. To some extent all parties to the conflict seem to be in agreement--we need to devise an approach that allows for the rational introduction of new health care technologies as well as the planned obsolescence of existing technologies. I should also note that I do not intend to offer a solution to the struggle over what organization or evaluative body might be most capable of resolving the complex issues surrounding heath care technologies. For example, it is yet unclear whether a private or public sector initiative is most suitable. In the end, perhaps, a combined approach is required, given the diverse interests that are involved. Setting aside these issues, my intent is to illustrate how the National Heart Transplantation Study is a prototypical study in the field of health care technology assessment. It is my contention that the Study represents the largest single health care technology assessment ever undertaken in terms of its comprehensive coverage of a diverse but very related set of issues (Evans et al., 1982; Evans, 1983c; 1983e). In terms of sheer dollars expended, however, the study is small in comparison with major clinical trials, such as the Coronary Artery Surgery Study (CASS) funded by the National Institutes of Health (Principal Investigators of CASS and their Associates, 1981; CASS Principal Investigators and their Associates, 1983a; 1983b; 1984; Braunwald, 1983). A clinical

trial, of course, is one approach to health care technology assessment (Banta et al., 1981).

My approach to this Chapter is quite simple. First, for those unfamiliar with the relatively new field of health care technology assessment, I think it is important that we attempt to come to grips with what constitutes a "health care technology." In doing so, I draw upon the exemplary work of the Office of Technology Assessment (OTA), the research arm of the U.S. Congress (Office of Technology Assessment, 1976; 1978; 1982; 1984; Banta, 1982; Banta et al., 1981). It should be recognized, however, that other government agencies have a vested interest in health care technology assessment, namely the Health Care Financing Administration, the Office of Health Technology Assessment, and the National Institutes of Health (Iglehart, 1983c; Brandt, 1984). To better understand the interests of these agencies, I have drawn upon the work of John K. Iglehart (Iglehart, 1977; 1983b; 1983c; 1984). Iglehart, a most astute student of health care policy, has periodically offered his views on health care technology (1977). These views are well-intended, balanced, and most insightful. It is impossible to take up the issue of health care technology without frequently citing Iglehart's work. In addition, others in the field deserve recognition for their work and, insofar as possible, I attempt to do so (Banta et al., 1981; Banta, 1982; Culyer and Horisberger, 1983). It can be said, however, that the scope of interest in health care technology is clearly international (Culyer and Horisberger, 1983). It is noteworthy that other chapters in this report, namely chapters 1, 2, 3, 4, 23, 25, 42, 43, 44, and 45 present material

relevant to health care technology assessment. Within the confines of the present Chapter, I have chosen not to reiterate many of the points made elsewhere in other chapters.

The title I have chosen for this Chapter--"An Excursion Into The Field Of Health Care Technology Assessment"--necessarily reflects the limits of understanding that I am able to impart to the reader. We must first realize that I am dealing with but a single technology--heart transplantation--which is truly life-saving. Not all technologies are nearly as complex as heart transplantation. When life is in jeopardy, few of us are able to take a "hardened" approach in an attempt to gain a better understanding of the difficult issues that are involved in choosing to apply costly medical technologies. In this regard, the surgeon who performs the transplant operation can hardly be expected to take an objective attitude--neither do I suppose that we wish that he or she would. Thus, in the remainder of this Chapter, I have attempted to reflect on my own experience as the Project Director of the National Heart Transplantation Study. To meaningfully accomplish this, I feel it is necessary to provide some perspective for those unfamiliar with the field of health care technology assessment. In doing so, I wish to underscore the fact, however, that while I characterize the National Heart Transplantation Study as prototypical, different health care technologies may lend themselves more readily to slightly different approaches to the assessment process. The views I express here are clearly my own and, as alluded to above, I do not take unequivocal positions on any of the key issues, in particular, how health care technology assessments are

conducted or who conducts them. From my perspective, the neutral observer role is essential to sound health care technology assessments. Despite the findings of an assessment, if this role is maintained throughout the assessment process, the assessment must be declared a success, provided, of course, a sound study design was the basis for the assessment. Not surprisingly, this approach is quite similar to that of an anthropologist studying a foreign culture.

B. WHAT IS HEALTH CARE TECHNOLOGY?

The scope of health care technology is considerable. The Office of Technology Assessment (OTA, 1978; Banta et al., 1981) has provided a definition of medical technology to guide assessment efforts. The OTA definition is as follows:

> The drugs, devices, and medical and surgical procedures used in medical care, and the organizational and supportive systems within which such care is provided.

Perhaps the only problem with this definition is that it is too inclusive, in other words, it is difficult to determine what fails to constitute medical technology. In this regard, the OTA staff has recommended that technologies have two dimensions--medical purpose and physical nature (Banta et al., 1981). These two dimensions can be further subdivided as follows:

> Medical purpose: (1) A diagnostic technology helps in determining what disease processes occur in a patient; (2) a preventive technology protects an individual from disease; (3) a therapeutic or rehabilitative technology relieves an individual from disease and its effects...; (4) an organizational or administrative technology is used in management and administration to ensure that

> health care is delivered as effectively as possible; and (5) a supportive technology is used to provide patients, especially those in hospitals, with needed services (e.g., hospital beds and food services).
>
> Physical nature: (1) a drug is any chemical or biological substance that may be applied to, ingested by, or injected into humans in order to prevent, treat, or diagnose disease or other medical conditions; (2) a device is any physical item, excluding drugs, used in medical care, and may range from a machine requiring large capital investment to a small instrument or implement; and (3) a procedure is a combination, often quite complex, of provider skills or abilities with drugs, devices, or both.

When considering the complex array of medical procedures, devices, and organizational arrangements, it is obvious that medicine, according to the OTA definition, is highly technological. Moreover, medical practice is targeted toward the overall goals envisioned for medical technologies that are classified as medical purpose. In other words, the clinician strives to prevent disease, treat it when it occurs, and, in the case of incurable and chronic conditions, to enable the sick person to cope physically and mentally (i.e., supportive technology).

Organ transplantation clearly qualifies as a medical procedure, but it is actually more than that because, today, transplantation is only possible through the application of multiple technologies. For example, cyclosporine is a relatively new immunosuppressive drug intended to combat rejection of the transplanted organ (Kolata, 1983; Macek, 1983; Reitz et al., 1982; Reitz, 1982; Jamieson et al., 1983; 1984; Hakala et al., 1983; Ferguson et al., 1982; Cooley et al., 1983; Borel et al., 1977; Borel, 1982; Starzl et al., 1983; Hardesty et al., 1983; Merion et al., 1984; Evans, 1984b). Yet, cyclosporine itself

constitutes a technology--a drug. Also, new technologies enable transplant procedures to be performed with greater ease. For example, the venovenous bypass is commonly used to facilitate liver transplantation (Starzl et al., 1983). It, too, is a medical technology, in this case, a device. The fact that many technologies can be applied simultaneously makes health care technology assessment extraordinarily difficult since multiple technologies have synergistic effects. It is often unclear as to which of several technologies that are applied simultaneously produce any net gains in patient outcomes (e.g., survival, quality of life).

To illustrate the simultaneous application of several technologies, I will use liver transplantation as an example. Over the past 18 months, as we are all well aware, liver transplantation has gained much momentum (Starzl et al., 1983; Calne, 1983; Sherlock, 1983; Halata, 1983; Gunby, 1983a; Scharschmidt, 1983; Notes and News, 1983; Consensus Conference Report, 1983; Evans, 198d; 1983e; Evans, 1984a). It was thrust into the limelight as the treatment of choice for end-stage liver disease, not because the surgeons who developed the procedure became more proficient surgeons, but rather because cyclosporine appeared to have overcome some very significant nonsurgical problems. These problems have to do with the management of the transplant recipient. This is not to say that modest improvements have not been made in surgical technique as the volume of liver transplant cases has increased. In fact, other procedures such as the venovenous bypass have been helpful in the conduct of surgery. Ultimately it is difficult to sort out the effect of these

technologies on patient outcomes. Some have contended for example, that cyclosporine, being a difficult drug to monitor, has forced clinicians to follow-up patients to a greater extent than in the past (Holt and White, 1984; Salaman, 1984). As a result, improvements in patient outcomes may be due to more intense follow-up than cyclosporine per se.

It is doubtful whether the independent effects of several simultaneously applied health care technologies can ever be assessed unequivocably. Since much of medicine involves more than the application of a single technological innovation, any health care technology assessment must carefully identify the component parts of the assessment. While it is desirable if the technologies be categorized appropriately as emerging, new, or existing, it is often the case, however, that emerging or new technologies are combined with existing technologies, producing a hybrid technological approach to the treatment of sick patients.

C. WHY ASSESS HEALTH CARE TECHNOLOGY?

Depending upon one's perspective, health care technology assessments can either be viewed as beneficial or as barriers to progress. They are considered beneficial if they facilitate the introduction of new technologies and allow us to plan accordingly. They are barriers if they derail the efforts of private industry to infuse new and needed health care technologies into the health care field. Nonetheless, it seems that those who favor health care technology assessment, as well as those who view such activities

suspiciously, agree that health care technology assessments can have positive outcomes (Culyer and Horisberger, 1983; Bunker et al., 1977; 1978; Fineberg and Hiatt, 1979; McKinlay, 1981; Bennett, 1977; Reiser, 1978; O'Brien and Marchand, 1982). To better understand these outcomes, Banta and coworkers (1981:11) have identified four primary concerns about technology. They are follows: (1) benefits, (2) risks, (3) costs, and (4) social impacts. I will now dwell on each of these briefly, intent upon providing a basis for health care technology assessment.

At the outset we must recognize that all health care technologies are thought to be beneficial, otherwise there would be little reason to introduce them into the health care delivery system. History is replete with many examples of highly effective technologies, perhaps vaccinations are foremost among these. A whole host of infectious diseases are now controlled as a result of vaccinations (Dubos, 1965). Many of these diseases have been both lethal and dangerous, among them, for example, are epidemic meningitis, epidemic typhus, bacterial endocarditis, smallpox, whooping cough, and so forth (Thomas, 1974; 1977).

Not surprisingly, as a result of vaccinations, infectious diseases have now largely been replaced with chronic diseases as the leading causes of death. Yet, many of these chronic diseases have also been effectively controlled through medical technology. Some examples are pellagra, rickets, scurvy, Addison's disease, juvenile diabetes, and certain types of cancer (Bennett, 1977; Banta et al., 1981). It is also true, however, that numerous "halfway technologies" have evolved

to treat various end-stage diseases, organ transplantation being among these (Thomas, 1974; 1977). Thomas notes that a halfway technology is "...technology designed to make up for disease, or to postpone death." It is precisely these technologies that raise serious questions about the benefits that are offered to patients. Unfortunately there is frequently a tendency to overemphasize the minimal benefits afforded by halfway technologies.

Health care technologies often have numerous risks associated with their use. Drugs such as thalidomide immediately come to mind. Even a procedure such as tonsillectomy results in as many as 300 deaths per year in the United States (Banta et al., 1981).

Other technologies have risks that are not immediately obvious. X-ray examinations are clearly a source of concern, as our desire to diagnose diseases in advance can actually facilitate the occurrence of the condition we hope to diagnose (e.g., cancer).

Ultimately health care technologies must be evaluated in terms of both their risks and their benefits. Unfortunately, it is not always easy to quantify these in a way that permits direct comparisons.

A third concern that most share about health care technology is cost. Rapidly rising health care expenditures, now consuming nearly 11.0 percent of the Gross National Product, is partially attributable to technological innovation. We now have very expensive means to keep people alive. Even a decade ago many of these people would have died. Banta and coworkers (1981:18) estimate that "...technology accounts for up to 50 percent of the increase in the cost of hospital care over the last decade." It is yet unclear which have been the

larger contributor to increased cost--large ticket items such as CAT scanners or small ticket items such as laboratory tests.

Estimates of the costs of discrete technologies have been offered. For example, intensive care alone has been found to account for approximately 15 percent of 1975 hospital costs (Russell, 1979). The costs of CAT scanning clearly exceed $500 million per year (Banta, 1980). The cost of renal dialysis is rapidly approaching $2.0 billion per year. Finally, as noted by Banta and coworkers (1981:19), the costs of diagnosis appears to be rising rapidly, with a cost of clinical laboratory services between $15 and $10 billion a year and a cost of X-rays of about $5 billion per year.

The last concern voiced by most in the health care technology field is directed to the social impacts of technology. Over time the issues raised by health care technology, particularly halfway technologies, have become no less complex than they were when it was first recognized that lives could be saved with potentially minimal benefit to the patient. As noted in the introduction to this Chapter, organ transplantation has, once again, forced us to confront these issues. The issues include questions such as the following: Who shall receive an organ transplant? How should we decide? What are the long-term consequences of organ transplants? Who will pay? What is a proper role for the federal government? How do we treat the medically indigent? These questions are both complex and nearly metaphysical (Evans, 1983a; 1983b).

In reflecting on the social impacts of medical technology Banta and coworkers (1981:19) have noted that medical technologies affect the following:

> (1) ethics and morals, changing or challenging our fundamental values or beliefs; (2) the legal and political system, pertaining to allocating scarce resources, defining death and life, informed consent, and so on; and (3) the economic system, going beyond issues of the cost of health care by affecting such factors as employment, productivity, and the necessity for and size of income maintenance programs.

Clearly, while the development of medical technology is in the best interests of all, including the healthy, the implications of medical technology can often go beyond the mere practice of medicine. Ultimately decisions must be made as to how society will allocate the available resources. Such decisions are necessarily somewhat removed from the practice of medicine per se (Evans, 1983a; Evans 1983b; Evans, 1983d).

D. WHO IS RESPONSIBLE FOR HEALTH CARE TECHNOLOGY ASSESSMENT?

As noted in the introduction to this Chapter, several government agencies share an interest in health care technology assessment. Through both intramural and extramural activities, the majority of health care technology assessments are performed by a handful of governmental agencies. Further technological assessments are undertaken by private industry, private insurance companies, private foundations, and medical and professional associations. Unfortunately, many of these assessments are poorly coordinated, if coordinated at all. While some of these groups have been at odds with each other over the conduct of health care technology assessments, a more cooperative spirit has been engendered by Medicare's new prospective payment system (Anderson and Steinberg, 1984; Wennberg et

al., 1984; Levine and Abdellah, 1984; Fetter et al., 1980; Thompson, 1983; Simborg, 1981; Office of Technology Assessment, 1983; Lee and Wallace, 1972; Vladeck, 1983; Iglehart, 1982a; 1982b; 1983a).

Iglehart (1983c) has observed the events of the day and has systematically reviewed them. However, he does not consider the demise of the National Center for Health Care Technology (NCHCT). The NCHCT was previously founded with the intent that it would provide other federal agencies, such as the Health Care Financing Administration (HCFA), with up-to-date technology assessments. Perry (1982a; 1982b) has provided the details of the demise of this organization. He attributes much of the controversy to the Health Industry Manufacturer's Association (HIMA). More recently HIMA has been supportive of the Prospective Payment Commission (ProPAC) which is responsible for the periodic revisions that must take place in the prospective payment system, specifically, revisions in the diagnosis-related grouping (DRG) rates.

As described by Iglehart (1983c), until prospective payment, hospitals and other health care providers had relatively little incentive <u>not</u> to adopt new innovations and technologies. Under the cost-based payment approach, costs associated with new technologies were simply passed on to third party payers. Now, under the DRG system, hospitals are paid under a per-case payment approach and consequently an automatic increase in revenues does not cover the added cost of new technology. As Iglehart (1983c) notes, "new technology will have to compete with alternative uses of scarce hospital funds." He concludes that "...with limited resources,

hospitals will need to assess new technologies and the added costs of this operation and maintenance far more closely and will have to allocate resources with greater prudence."

The looming fear of the manufacturers of health care technology is that the Health Care Financing Administration, with administrative authority for the Medicare program, will be only sensitive to cost-control considerations as it adjusts Medicare prices in the future. This, in turn, will discourage hospitals from purchasing additional capital equipment (Anderson and Steinberg, 1984). HIMA has been supportive of ProPAC as it sees this commission as an effective counterweight to HCFA. ProPAC is made up of 15 members that have been charged by Congress with making recommendations to the Department of Health and Human Services (DHHS) on the appropriate rate for services rendered to Medicare patients. In addition, ProPAC will have responsibiity for conducting assessments of medical technology and will have grant funds to pay for extramural assessments. All ProPAC activities, however, are advisory.

Interestingly, surgical procedures such as transplant operations are somewhat less directly affected by the activities of ProPAC and HCFA. In the case of a procedure, such as heart transplantation, the ability of an institution to undertake a program has less to do with capital equipment expenditures than it does with the skills of surgeons. If a hospital is already equipped for open-heart surgery, few additions are required to permit the initiation of a heart transplant program. Thus, surgical procedures fall outside the usual domain of regulatory approaches such as certificate-of-need

requirements (Salkever and Bice, 1976; 1979). Nonetheless, the diffusion of heart transplantation among hospitals is to some extent limited by the extent to which the procedure is found acceptable enough to warrant a separate DRG. Thus, with regards to surgical procedures, the health care industry is certainly much less affected than the surgeons who want to start a heart transplant program.

ProPAC is the newest of several organizations that seeks to conduct assessment of medical technology. The most highly visible organization is the Office of Technology Assessment, although the Food and Drug Administration (FDA) has had a long-standing responsibility for approving drugs and devices (Nightingale, 1981). Less visible, perhaps, is the highly important role teaching hospitals and clinics have had in determining the effective use of medical technologies.

Iglehart (1983c) has commented on the roles of various other organizations. For example, the American Academy of Pediatrics is concerned with immunization practices, the American Public Health Association with preventive and therapeutic procedures for infectious diseases, and the American Hospital Association and the American College of Radiology, as well as the American Medical Association, have all been involved in similar activities. Of these organizations, the newest venture has been the Diagnostic and Therapeutic Technology Assessment Program of the American Medical Association. Through the use of physician panels, this program addresses questions on the safety and effectiveness of medical technologies, the results of which are routinely published in the Journal of the American Medical Association.

Other groups concerned with health care technology assessment include the American College of Physicians (e.g., Clinical Efficacy Assessment Project), and the Blue Cross and Blue Shield Association's Medical Necessity Project which began in 1976.

Within the Public Health Service, the National Center for Health Services Research (NCHSR) through its Office of Health Technology Assessment routinely conducts assessments of health care technology. This office submits reports to the Health Care Financing Administration on the safety and efficacy of technologies. These assessments, however, do not include economic, ethical, or social considerations. The Office of Health Technology Assessment, now headed by Dr. Enrique Carter, is routinely swamped with requests for assessments and has great difficulty completing them in a timely fashion (Iglehart, 1983c). As a result, this office draws upon other entities within the Department of Health and Human Services, most important of which is the Office of Medical Applications of Research (OMAR). Finally, the Health Care Financing Administration, which funded the National Heart Transplantation Study, also conducts technological assessments although it frequently relies on the judgements of the National Institutes of Health concerning scientific issues that "involve technology and its value in medical care" (Iglehart, 1983c; Perry and Kalberer, 1980; National Institutes of Health, 1981; Rennie, 1981; Consensus Conference, 1984a; 1984b; Stocking and Jennett, 1984).

Ultimately it must be concluded that there is no central source or clearinghouse for information on health care technologies. Also,

while the procedures for assessing drugs and devices are relatively straightforward, they are by no means uniform for most new medical technologies, including surgical procedures. For these reasons, it seems particularly appropriate to turn my attention to how we conducted the National Heart Transplantation Study. This prototypical study, provides a strong basis upon which future assessments of surgical procedures might be conducted. The success of the study doubtlessly depends upon the reception of this full report by medical professionals, patients, patient advocates, and policymakers.

E. THE NATIONAL HEART TRANSPLANTATION STUDY: A PROTOTYPE ASSESSMENT OF SURGICAL PROCEDURES?

At this point I do not intend to reiterate the history of the National Heart Transplantation Study. I have already provided an historical overview in Chapter 1 of this report. Instead, I will now consider the framework for the study. In this regard it is noteworthy that many of the people involved in the formulation of the request for proposals for the study and the preparation of background materials were well aware of the complexities of the issues involved. This includes representatives from the Health Care Financing Administration, the National Heart, Lung, and Blood Institute, and the National Center for Health Care Technology (Newman, 1980; 1981).

A cursory review of the materials relating to the study clearly revealed that the primary issues could be arranged into several categories. We did this in order to assemble the necessary staff to undertake the required analyses. The areas we settled on were as follows:

1. The need for heart transplantation.
2. The supply of donor organs.
3. The survival of transplant recipients.
4. The quality of life outcomes experienced by patients.
5. The cost of performing a heart transplant.
6. The legal issues associated with heart transplantation.
7. The ethical dilemmas surrounding heart transplantation.

Another issue, although addressed in our research proposal, but not elevated to the status of a study component, was the potential diffusion of heart transplantation. The fact that this issue is not allotted component status should not diminish its significance. In fact, in a memorandum from Dr. Peter L. Frommer to the Director of the Coverage Assessment Staff of the National Center for Health Care Technology on January 21, 1980, a serious concern was expressed about the proliferation of centers.

At this point it probably seems repetitious to reconsider each of the study components. The results of the study have been presented in preceding chapters. While this may be true, this is a convenient time to once again emphasize the interrelationships among the many parts of a technology assessment. It is also appropriate to underscore the diverse data that are required to make a reasonable assessment of any technology.

1. NEED ESTIMATION

At the outset of the study we felt it was extremely important to derive precise estimates of the need for heart transplantation (Evans, 1982). Over time, however, we recognized that the supply of donor organs was such that even with imprecise estimates of need, the number of available organs for transplantation would prove unsatisfactory. We did not abandon our efforts, however, to produce precise estimates of need because we were well aware of advancements that had been made in the development of the totally implantable artificial heart as well as a variety of cardiac assist devices. Thus, while it was unnecessary for us to invest a substantial amount of time and effort in the assessment of the need for cardiac transplantation, we felt it would be shortsighted to abandon our efforts prematurely. We asked ourselves: what if a viable artificial heart were to become available? If it did, we would then have a situation where the treatment of end-stage cardiac disease would be similar to the treatment of end-stage renal disease. In this regard, we felt we should be prepared to better address the issues associated with the artificial heart. To do this, we needed to produce both reliable and valid estimates of need. This is not to say our estimates are flawless. When considering an approach to the estimation of disease prevalence, such as that of Manton and Liu (1984; also see Manton and Stallard, 1982), our estimation procedures leave much to be desired. At the same time, however, we recognized the prevalence of cardiovascular diseases was declining and new treatment

methods were evolving rapidly that could render both heart transplantation and other forms of cardiac replacement obsolete.

We remain convinced of the importance of need estimation (see Evans and Blagg, 1981). We sometimes refer to the need aspect of our work as an epidemiological analysis. This is because need for a health care technology is closely related to the prevalence of the conditions for which health care technologies have been devised to treat. Unfortunately, the kinds of data required for these analyses are often unavailable. In short, good population-based epidemiological data are hard to come by. If they are available, they are often limited in scope. For example, the Framingham heart data are limited in at least two ways (Woodbury et al., 1979; Dawber, 1980). They are primarily concerned with heart disease in a relatively small geographical area. While such data may be excellent for looking at disease epidemiology, they are of limited value in estimating the need for heart transplantation within the U.S. There are other sources of epidemiological data that cover a vast number of diseases and conditions but these are often limited in geographical representation. For example, the data accumulated by the Mayo Clinic on the residents of Olmsted County, Minnesota would fall in this category (Grabow et al., 1984; Kurland et al., 1970).

Our conception of need in health care technology assessments is somewhat more simplistic, but often more realistic than that offered by others. For example, White (1983:7) has defined several different types of need as being critical to health care technology assessment. He describes perceived need as "...the individual's

expectation that information, services and assistance can improve current functional capacity and well-being or avoid incapacity, disease, and pain." White (1983) also makes note of "socially determined need" and "professionally defined need." Socially defined need has to do with the protection of the public against a variety of diseases that clearly threaten public health such as venereal disease and other communicable diseases. What he refers to as professionally defined need is consistent with what we have called epidemiologically-based need. Finally, White (1983) describes the demand for health services, as "expressed," "effective," and "potential." Although these definitions are useful, they are frequently difficult to measure.

While we agree there are variations in the process of defining need, the primary estimates of the need for technology must always be those based on reasonable epidemiological data. Having derived such estimates, the entire assessment process can be tailored to yield more refined estimates of need that may be consistent with other conceptions of need.

2. SUPPLY AND AVAILABILITY ESTIMATES

In the analysis of heart transplantation, the concept of supply really applies to the availability of donor organs and the number and distribution of institutions that perform heart transplants. It is noteworthy that the availability of a cardiac assist device or a totally implantable heart markedly affects estimates of availability because the supply of a mechanical device is potentially sufficient to meet the need for it. Also, in producing supply estimates it is

important for us to consider the number of institutions that are adequately equipped to offer heart transplantation.

Therefore, to summarize, the supply of heart transplantation is ultimately determined by several factors, including: (1) the availability of donor hearts, (2) the number of institutions performing the procedure, and, additionally, (3) a person's ability to pay. In our analysis of heart transplantation, we have to a greater or lesser extent focused on each of these, although donor organ availability is clearly the most significant constraint on supply.

In estimating the supply of donor hearts we were careful to produce estimates based on varying assumptions. For example, we distinguish between potential and actual donors. We have demonstrated the supply of actual donors is insufficient to meet the demand or need for heart transplantation but the potential supply may be adequate. The difference between the number of actual and potential donors tells us what we must strive to achieve if the goal is for supply to meet need. It also tells us what we might maximally achieve in terms of donor organ availability.

Constraints on donor organs is what makes organ transplant procedures uniquely different from other health care technologies. The supply of a drug can be potentially increased to meet the need for it, as can most medical devices. It is impossible, however, to produce a human heart. With the availability of an artificial heart or assist device, the problem of supply becomes less formidable (Jarvik, 1981; Lubeck and Bunker, 1982; DeVries et al., 1984;

Galletti, 1984; DeVries, 1983; Cortesini, 1984; Caplan, 1984; Atsumi, 1984). As noted above, there are, nonetheless, other constraints on supply. The first of these concerns providers. It is reasonable to ask: who is capable of performing the required transplant or, in the case of an artificial heart, the implant? If the number of individuals who are qualified to perform the procedure is limited, and thus the number of institutions offering the treatment is few, then a problem of supply is likely to persist. Over the past year this, of course, has been at least one problem associated with pediatric liver transplantation. Initially the University of Pittsburgh group reported that the supply of liver donors was insufficient to meet the need for the procedure (Kolata, 1983a; Gunby, 1983b; 1983c; Evans, 1984a; Spees et al., 1983). Within a few months this situation had completely resolved itself and donor organs were being refused because the transplant teams were unable to keep up at a frantic pace. Potentially the unused organs could have been used if more teams were performing liver transplants. In short, the shortage of liver transplant programs, not donor organs, constrained the supply of liver transplant procedures.

The third constraint on supply is largely economic--the ability to pay. If a person is unable to pay for a procedure they require and there is no assistance from a third party, then the supply of the procedure is also constrained. This is the constraint which most people find unpalatable, or certainly least palatable. The assumption here is that there should be essentially no economic barrier to health care. In principle this may be true, but in

practice it is not. Over the past 18 months many people have been turned down initially for transplant operations because they have been unable to pay. In almost all cases, however, a solution has been found to the economic impasse. Private fund raising efforts and the reversal of previous refusals by public and private insurers have surely increased the supply of organ transplant procedures.

In the final analysis, supply-induced problems associated with the number and distribution of transplant centers and the finances required to gain access are potentially resolvable. The problem of donor organ supply, however, is not remedied easily. This, undeniably, makes the analysis of the supply of organ transplant procedures somewhat different from the analysis of the supply of other health care technologies.

3. PATIENT OUTCOMES

Outcome assessment is clearly critical in the analysis of any health care technology. The outcomes of interest, however, depend upon the nature of the technology being assessed. For example, in the case of life-saving technologies, patient survival is important. But patient survival is rarely a consideration in the analysis of diagnostic devices. Yet, patient survival may be critical in the evaluation of preventive technologies such as immunizations. Another outcome of interest, as revealed by concerns about quality of life, is how well patients do following a technological intervention such as an organ transplant. Although difficult to measure, quality of life is a primary consideration (Campbell, 1976; Bradburn, 1969; Bradburn and Caplovitz, 1965; Andrews and Withey, 1976; Andrews, 1974; Rodgers and

Converse, 1975; Campbell et al., 1976; Campbell and Converse, 1980). Researchers have now made explicit the quality versus quantity of life tradeoffs associated with both new and existing technologies (McNeil et al., 1981; McNeil et al., 1982; McNeil and Pauker, 1982).

Let me begin by dwelling on patient survival as perhaps the most important consideration in the assessment of new life-saving technologies. Survival is the most important outcome because a technology can hardly be considered life-saving if respectable patient survival rates are not achieved. A threshold level of survival must be achieved before practitioners are willing to adopt a new technology. For example, the enthusiasm currently surrounding many transplant procedures, including hearts and livers, is that respectable survival rates have been achieved (Kraukauer et al., 1983; Vollmer et al., 1983; Evans, 1984b). As a result, these procedures have gained therapeutic status in some circles and third party payers have begun to reimburse for both heart and liver transplants. This in itself spurs greater interest in the diffusion of transplant programs. This diffusion, however, may, in the short-run, be detrimental if new teams are unable to match the results of very experienced teams. This, in effect, constitutes the difference between the efficacy of a procedure and its effectiveness. Banta and coworkers (1981:98) have distinguished these concepts as follows: efficacy is the probability of benefit to individuals in a defined population from a medical technology applied for a given medical problem under ideal conditions of use. Effectiveness, on the other

hand, is concerned with the benefit of a technology under average conditions of use.

Our experience with new technologies suggests that after a certain threshold level of survival has been achieved, attention often shifts to quality of life issues (Rosenfeldt et al., 1983; Rimm et al., 1976; Love, 1980; Jenkins et al., 1983; Hammermeister et al., 1979; Frick et al., 1979; Barnes et al., 1977; Christopherson et al., 1976; Pennock et al., 1982; Stanton et al., 1983; Christopherson, 1982; Hammermeister, 1983). Frequently, the quality of life outcome given primary attention initially is employment status. It is often assumed that if a patient is able to return to their pretreatment major life activity they necessarily have a higher quality of life than those who have been unable to do so.

Quality of life can be measured in numerous ways, but the assessment of quality of life is complicated by the fact that it is influenced by many factors other than disease, such as lifestyle, interactions with the health care system, and treatment (Balaban and Goldfarb, 1983:26). As described in Chapters 23 through 26, a variety of indicators of quality of life have been incorporated into our analyses of heart transplant recipients including functional impairment, ability to work, health status, well-being, psychological affect, and overall life satisfaction. Should such measures be neither reliable nor valid, any assessment will necessarily be faulty.

In our own work we have shown that quality of life is a multidimensional concept. This is an important factor to be

considered in the assessment of the quality of life associated with life-saving technologies (Evans et al., 1984). For example, on some dimensions of quality of life (not just indicators), patients may do very well, while on others they do poorly. The question then becomes, what constitutes quality of life? It is unfortunate that often there is not perfect covergence on all quality of life indicators. Perhaps over time we will become more proficient in our measurement of quality of life or perhaps our theory about quality of life will differ substantially from what it is today. Our measures will obviously change with our theories of quality of life.

To summarize, beyond the very initial stages of development, technologies can only be understood in terms of the benefits associated with them. Good technologies yield considerable benefits, while poor technologies have relatively little to offer patients. These latter technologies are eventually abandoned. It is in this regard, that the thoughts of Fox and Swazey (1974) and Swazey and Fox (1979) on a clinical moratorium are particularly relevant. These will be discussed further in Chapter 42.

4. COST

As a technology enters mainstream medicine, concerns are inevitably expressed about cost. Almost no technology is without cost although the benefits of some are clearly disproportionate (in both directions) to the benefits they provide. The search, of course, is for technologies that yield high benefits at little expense. The problem with assessing costs is that they change rather frequently depending upon the stage in the development of the technology.

Generally it is expected that costs (and I am purposely ignoring the cost versus charges issue here) will decline over time. Unfortunately, medicine seems to be different than other parts of our economy. Costs, if they decline, often do so very slowly.

Neuhauser (1979) has proposed a "product life-cycle curve for medical technology" that allows us to gain some understanding as to why costs should decrease over the lifetime of a product (Williams, 1983). He describes four stages in the life-cycle curve. They are as follows:

1. The idea period. This is largely an expensive period in the life of a technology as the producing company has invested a considerable amount of money but is yet to see a return on this investment. Articles begin to appear in medical publications that are likely to be wildly enthusiastic about the new technology.

2. Adaptation. At this stage their is growing acceptance of a new technology although the company producing the technology is still not realizing a net return. In fact, at this point the technology may be undergoing some very expensive randomized trials with several years of follow-up.

3. Acceptance. At this stage the producing company may begin to realize some return on investment although the reports emerging in the literature are probably less enthusiastic than they were initially. However, now hospitals have invested in equipment and doctors have learned the necessary skills and the climate has changed. Unless subsequent reports in the literature show clearly harmful results they may have little effect on changing medical behavior.

4. Decay. Eventually a technology falls out of use. It is at this point that the producing company determines precisely how successful their innovation has been. This stage may be easy if the technology is replaced with something new, or very difficult if there is nothing to replace it.

Economic evaluations of health care technologies generally follow a cost-effectiveness or benefit-cost framework. These techniques are essentially tools for the analyst and the results they produce are only as good as the data that have been incorporated in the overall model. Many people feel uncomfortable with these techniques and they have recently come under fairly strong attack (Vladek, 1984; Avorn, 1984).

I have chosen not to describe these techniques at length since there are several standard references now available (Weinstein and Stason, 1977; Office of Technology Assessment, 1980; Weinstein, 1983; Avorn, 1984; Weinstein and Stason, 1976; Weinstein et al., 1980; Schwartz and Joskow, 1978; Warner and Luce, 1982). In general, these approaches attempt to assign specific numerical values to the benefits of medical interventions of various kinds, as well as their costs. Once quantified, costs and outcomes are then compared to indicate which health care interventions make the most efficient use of resources (Evans, 1983b). Benefit-cost analyses (BCA) reduces all factors to a common unit of measurement, generally dollars; cost-effectiveness analyses (CEA) likewise expresses treatment costs in dollars, but leaves outcomes in terms more recognizable to the clinician, for example, number of life-years saved (Avorn, 1984; Williams, 1983; Culyer, 1982; OTA, 1982; Weinstein et al., 1982).

As indicated, the primary purpose of CEA and BCA is to assist policymakers in resource allocation decisions (Evans, 1983a; 1983b). In conducting these analyses, however, there must be some standards for comparison. A CEA or a BCA cannot otherwise be conducted. In the

case of heart transplantation, for example, it is appropriate to compare the cost of a heart transplant with the cost of routine medical and surgical management of the end-stage cardiac disease (ESCD) patient. Many analysts fail to take such comparisons and, as a result, fail to differentiate the cost of a procedure from the cost of treating the disease. For example, the treatment of ESCD in the absence of a transplant is not without cost. Many analysts and policymakers have failed to consider this (Reiss et al., 1982; Hellinger, 1982). A proper analysis, such as that undertaken in this report, attempts to account for the costs of treatment in the absence of a heart transplant.

The complexities of the cost issue do not end here, however. Policymakers are frequently faced with decisions about the comparative use of scarce resources. In this regard, it is appropriate to compare the cost of heart transplantation with the costs of other procedures that are considered acceptable and are covered and reimbursed for by public and private insurers (Evans, 1983b). For example, lifetime maintenance dialysis appears to exceed the cost of a heart transplant and, in the case of home hemodialysis, the net benefits gained by patients are similar, both in terms of survival and quality of life (see Chapters 25 and 42). Also, third party payers routinely cover the costs of care for patients dying with cancer even though the prognosis for many of these patients is inferior to that of heart transplant recipients.

Thus, in the end, both cost-effectiveness and benefit-cost analyses force us to face the larger questions concerning resource

allocation (Fuchs, 1974; Calabresi and Bobbitt, 1978; Anonymous, 1983; Leaf, 1984; Schwartz and Aaron, 1984; Cochrane, 1971; Evans, 1983a; 1983b; Adel, 1984; Aaron and Schwartz, 1984). In doing so, they provide the basis for consistently applied social policy, even though the policy itself may be disagreeable to many.

5. LEGAL AND ETHICAL ISSUES

Heart transplantation, as do all health care technologies, raises numerous difficult legal and ethical issues. I have chosen here to discuss them simultaneously, although throughout the report they have been the object of separate analyses by both legal and ethical experts. My intent here is not to cover the full gammit of issues, but rather to underscore the generic nature of selected issues (Englehardt, 1984; Callahan, 1980; Clements and Sider, 1983; Veatch, 1981; Winslow, 1982; Abram and Wolf, 1984; Annas, 1984; Angell, 1983; Bayer et al., 1983a; 1983b; Caplan, 1983; Beauchamp and McCullough, 1984; Childress, 1982; Gorovitz, 1982; Gorovitz et al., 1983).

Over the course of the past eighteen months much attention has focused on the selection of transplant recipients. In Congressional testimony both legal experts and medical ethicists have expressed reservations about the patient selection process. While physicians have frequently cited medical need as the basis upon which candidates have been selected, it is apparent that occasions arise when two or more people are in desperate need and, to some extent, compete for the available organs.

The legal analyses contained in this report have focused on how different laws such as the Age Discrimination Act and Section 504

of the Rehabilitation Act impinge upon the patient selection process. This analysis showed that the patient selection criteria for heart transplant recipients cannot be easily administered within the confines of existing law.

The ethical analyses have focused more on the patient selection process than on the characteristics of those selected for heart transplantation, although concern was expressed about the latter. A variety of methods are available to select recipients such as "first come - first served" and a lottery.

A second issue addressed in both the legal and ethical analysis was the donor of the transplantable organ. Neither donors nor recipients have been granted the anonymity that they rightfully deserve. The tragic circumstances of some donors have appeared on the front pages of newspapers and have served as top stories in news reports across the country. Also, recipients have become so well-known that their names are well-recognized within most households across the U.S. Take, for example, Jamie Fiske and Brandon Hall. Such intrusions on the privacy of individuals and families is viewed as problematic.

Other donor-related issues include brain death statutes and their administration as well as the buying and selling of organs. Both these topics have been the object of much discussion. Newspapers have highlighted stories where persons considered as organ donors were really not "dead." Recently, the buying and selling of organs became a key consideration as several living persons took out advertisements

in major newspapers to sell kidneys to persons who were in need of kidney transplants.

The selection of recipients and the identification of donors are not terribly generic issues when it comes to health care technology more generally, although they certainly apply to other organ and tissue transplant procedues. Perhaps the most generic of issues are limits on the practice of medicine and resource allocation and rationing decisions. From time to time proposals have been offered to permit the designation of extrarenal transplant programs to prevent widespread proliferation of these facilities. The American Society of Transplant Surgeons (ASTS) was very supportive of one such proposal while the American Medical Association was very opposed to it. Their opposition was based on premises of antitrust (Curran, 1984; Gross, 1984; Tabor, 1984. It was argued, for example, that the designation of transplant centers represented an unfair restriction on medical practice.

This issue is not new and there have been instances in the past where attempts have been made to limit the diffusion of certain technologies such as CAT scanners. More recently, nuclear magnetic resonance has raised similar questions. It is often argued that limitations on diffusion serve to enhance the overall quality of care that is delivered. In order to accomplish this, a variety of approaches are available including licensing, accreditation, and certification (Banta et al., 1981:161-162).

The basis for the designation or regionalization of heart transplant programs was provided in a memorandum from Dr. Peter L.

Frommer to the Director of the National Center for Health Care Technology (NCHCT) on January 21, 1980 (see Appendix 1-A and 1-B in Chapter 1). In his memorandum, Frommer made note of the following:

> It is recommended that:
>
> 1. Cardiac transplantation be accepted for reimbursement at those centers which have experience, which utilize the Stanford criteria for patient selection and the essential features of the Stanford procedure for patient management.
>
> 2. Further centers be accepted for reimbursement only if they:
>
> a. demonstrate the expertise and resources necessary for the procedure,
>
> b. fully adhere to the protocol for patient selection and at least the essential criteria for patient evaluation and therapeutic procedures upon which these recommendations are made,
>
> c. are part of a regionalized plan (i.e., represent a center for cardiac transplantation for a region of reasonable dimensions in terms of needs, medical manpower, and logistics).

Frommer also alerted the Director of the NCHCT to the possibility that there would be a "proliferation" of centers and a gradual relaxation in patient selection criteria (also see Luft et al., 1979; McGregor and Pelletier, 1978; Moore, 1982; Finkler, 1979; Leaf, 1980a; 1980b; Moore et al., 1968).

The final generic legal and ethical issue I have alluded to concerns the process of making resource allocation decisions. To a great extent this issue is probably more ethical than legal. Heart transplantation, like many expensive health care technologies, raises questions about how society should allocate resources. For example,

some would argue that the resources expended on heart transplantation would be better spent for other purposes. This is precisely the point that D.W. Evans (1984) made when he argued that, in England, resources allocated to cardiac transplantation would be better spent on the "routine cardiac service." This argument is not new, it has often been made in connection with other health care technologies. The problem is that such decisions are not made easily. Ultimately the issues are debated either directly or indirectly through the political process. Take, for example, the End-Stage Renal Disease Program in the U.S. There are doubtlessly other severely ill people in the U.S. who could benefit from a reallocation of resources away from this program, but the ESRD program has a very vocal and strong political constituency. The history of the program, in itself, is proof of how the political process can be manipulated to benefit a rather small constitutuency (Rettig, 1978; 1980a; 1980b; Iglehart, 1982; Blagg, 1983; Blagg and Scribner, 1980a; 1980b; Caplan, 1981; Evans et al., 1981; Fox and Swazey, 1974). As a result, whenever a question is raised about coverage for a new health care technology, the ESRD Program is inevitably used as an example. Also, the treatment of ESRD in England is often cited as a viable alternative to the current approach in the U.S. It is interesting, however, that the U.K.'s rationing approach is now being criticized regularly (Deitch, 1984; Anonymous, 1984; Brahams, 1984; Davison et al., 1984; Douglas, 1984; Heath, 1984). Not surprisingly, the federal government has become increasingly reluctant to grant full entitlement to Medicare benefits for any potential class of beneficiaries (see Chapter 44).

As described in Chapter 45, resource allocation decisions are extraordinarily difficult to make. On the one hand, we often have the means necessary to save a life, but on the other hand, the resources required to do so are great. This leads to questions about the value of life and what classes of individuals should be given priority for these resources. It is likely that in the future questions about resource allocation will be asked more frequently, as the technologies we develop become increasingly expensive. It is in this regard that heart transplantation underscores the importance of the resource allocation issue.

F. CONCLUSION

This chapter has brought together a discussion of many of the concepts critical to health technology assessment, identifies those agencies and organizations with a vested interest in technology assessment, and, finally, it has provided a framework within which health technology assessments can be undertaken. The National Heart Transplantation Study has been used as a case in point.

Up to this point we have not explicitly stated the goals of a health technolgoy assessment, we have only implied that such assessments have some utility. Perhaps by way of conclusion it is useful to be more direct in underscoring the utility of complex, costly, and time-consuming assessments.

First, we must recognize that the goals of health technology assessments may differ depending upon the agency that plans to underwrite their costs, or the agency or organization that plans to

use the results. For example, a pharmaceutical or medical device manufacturer is concerned about the profit that a new drug or medical device may turn. In this regard, a technology assessment is completed at the very earliest stages of research and development and is used as part of an overall marketing strategy. If the new drug or device does not appear profitable, it is likely to be abandoned before sizeable resources are expended to develop it. If, however, a drug or device is demonstrated to be potentially safe and efficacious, the manufacturer is likely to commit the necessary resources for its development. Once the drug or device has been developed and subjected to preliminary trials (i.e., clinical trials), public and private insurers become interested in its application. Eventually a decision will be made concerning coverage of the drug or device (Towery and Perry, 1981; Greenberg and Derzon, 1981). In the past, such decisions have been relatively straightforward. If, for example, a device was widely used by the medical profession, it was unlikely that insurers would exclude it from coverage. The same, of course, applied to new medical and surgical procedures. In effect, medical practitioners have traditionally dictated what they felt should be covered under insurance programs. If a question was raised, usually a group of medical consultants was called together to resolve a coverage issue.

Today the situation has changed. Whereas in the past cost was rarely a consideration in coverage determinations, today this has become a key issue. More importantly, the question asked is often of the cost-effectiveness type. When questions about cost-effectiveness are raised it becomes apparent that the medical profession is

ill-equipped to make coverage pronouncements without input from nonmedical experts. Traditionally, physicians have been taught to ignore cost as an issue. If the patient's health was at stake, the physician was expected to do everything possible to care for the patient, regardless of the cost implications. Most practitioners continue to operate in this fashion although they are finding it increasingly difficult to do so. They now find, for example, that every course of action they may choose to take is not necessarily "paid for" by the public or private insurer responsible for the patient's expenses. Thus, the medical profession finds itself confronting the uncomfortable situation of deciding what course of action to take based on reimbursement.

This entire situation becomes more complex when insurers ask the developers of new technologies to demonstrate that their technology or treatment approach is more cost-effective than already available approaches. It is not unusual for a manufacturer to develop a technology that is equally or more effective than a technology that is already available. However, the cost of the new technology may exceed the cost of already available technologies. If this is so, private insurers become more reluctant to pay or "cover" the new technology. Ultimately, therefore, manufacturers face a very difficult decision when deciding how best to allocate their research and development funds. The more cost-effective a technology, the more likely it will be covered. Marginal technologies, however, are unlikely to diffuse within the medical community, meaning that considerable research and development resources have essentially been lost. Consequently, it is

in the best interest of manufacturers to undertake extensive health care technology assessment both as part of their research and development decision making process and as part of their overall marketing strategy.

There is little question that today and throughout the foreseeable future insurers will dictate the course of technological development (OTA, 1984). In the past developers have enjoyed this role. Manufacturers and developers may once again dictate the future of health care technology if they embark upon the development of products after exhaustive technology assessments and have planned for the marketing of their products. Obviously, part of this marketing strategy must also include representatives from private and public insurer groups. Physicians, in many respects, will be a secondary concern. If insurers are convinced of the cost-effectiveness of a product, physician groups, because of favorable reimbursement, are likely to adopt the technology rather readily.

As noted in several chapters of this report, inductive reasoning that assumes the future will be like the past no longer seems to be true, or at least is consistent with the events of the day. Over the next decade, the practice of medicine will change greatly. There will be ever increasing concerns about cost and who shall be treated. Sonnenberg and coworkers (1983:209-210) have suggested "nine commandments contrary to conventional medical ethics." They are as follows:

. Thou shalt learn statistics and medical decision analysis and use them in thy clinical routine.

- Thou shalt not try everything thou can to treat thy patients and save their lives.
- Thou shalt not start any therapy--even though it be life-saving--when thy chances are lower than 10%.
- Thou shalt not prolong a man's life were it to mean that he live crippled and lame.
- Thou shalt not prolong a man's life if it be for less than 6 months.
- Thou shalt not care about probabilities lower than 1%.
- People want the physician to reassure, comfort, console, solicit, and take away all their fear, thou shalt not do this.
- Thou shalt not crave a diagnosis for every patient.
- Thou shalt have regard for the costs of thy measures and prescriptions.

These "commandments," it would appear, are worthy of consideration, but are unlikely to be readily accepted, even despite the pressures brought to bear by modern health care technology.

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CHAPTER 42

EXPERIMENT VERSUS THERAPY: IS THE DILEMMA WORTH THE DEBATE?

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A. INTRODUCTION

Over the past year controversy has raged concerning the experimental or therapeutic status of organ transplant procedures, particularly liver transplantation, but to some extent heart, heart-lung, and pancreas transplants. Lung transplants are generally perceived as experimental, as is transplantation of the small intestines. Of all transplant procedures, none are considered more therapeutic than kidney or cornea transplants. As implied by my choice of adjectives to describe these procedures, the view that surgical procedures are experimental or therapeutic in a dichotomous or absolute sense is inappropriate. Fox and Swazey (1974; 1978; Swazey and Fox, 1979; Fox, 1970; 1976; 1979), have systematically studied the experiment-therapy debate and offer the following observation:

> One of the most fundamental problems shared by all physicians trying out new treatments on sick patients is that of determining how experimental and/or therapeutic that treatment is. The usual discussions of this calculus, under the rubric of the "ethics of human experimentation," are too often couched in dichotomous terms of "experiment" or "therapy." In practice, however, one sees a process of therapeutic innovation which generally progresses from animal experiments to clinical trials with terminally ill patients beyond conventional therapeutic help, to the use of the treatment on less and less critically ill patients.

Clearly, progress in medical science is not an either/or proposition. The concept of progress is dynamic rather than static. To characterize progress in organ transplantation, or the application of any surgical procedure or medical innovation as being experimental or therapeutic is greatly misleading. Only at the very initial stages of development

can a procedure be said to be experimental and only when a procedure has been fully integrated into medical practice can it be considered therapeutic. At either of these two extremes the status of a procedure is self-evident and undebatable. Perhaps the concepts of questionable and acceptable should be superimposed along the experiment-therapy continuum to emphasize the uncertainties that surround many medical procedures that are beyond the experimental phase but are not yet therapeutic. Such a continuum might appear as follows:

This heuristic conception of the experiment-therapy delimma is central to the thesis of this chapter.

It is indeed difficult to establish at precisely what point procedures move from the gray area between experiment and therapy and become acceptable although not necessarily therapeutic. As Swazey and Fox (1979:347) note, there are no signposts telling physician-investigators that the time has arrived to freely apply a previously questionable procedure. In the case of surgery for mitral stenosis, Swazey and Fox (1979:347) argue that:

> ...physicians had continually to assess the state-of-the-art, their own capabilities, the probable risks and benefits to their patients, the possible yield in knowledge that might help other patients, and the proper allocation of scarce resources (manpower, equipment, facilities, funds).

The problem of innovation in medicine is a significant concern to clinicians, their patients, and policymakers responsible for charting

the course of health care delivery (Bunker et al., 1978; Fineberg and Hiatt, 1979; Relman, 1980; Banta et al., 1981; Banta, 1982; OTA, 1982; Culyer and Horisberger, 1983).

In order to assist all those concerned, several medical professional associations and the National Institutes of Health have established various mechanisms to help identify when a procedure or medical technology has reached a transitional point (Jones, 1983; Relman, 1982; Sammons, 1983; Iglehart, 1983). Among these mechanisms is the consensus development conference program of the Office of Medical Applications of Research (OMAR) at the National Institutes of Health (Rennie, 1981; Frederickson, 1978; Barclay, 1978; Perry and Kalberer, 1980). Consensus statements generated by such groups serve as the primary signposts of the status of a variety of medical technologies (drugs, procedures, and devices).

It is not surprising that organ transplantation has renewed interest in the experiment-therapy dilemma. Often reimbursement by public and private insurers hinges on the status of a procedure--reimbursement is withheld for experimental procedures, but not for those considered therapeutic. Also, although not recognized by most, the status of a procedure is an important determinant of research support. If a procedure is therapeutic, less research funding is made available through sponsoring organizations such as the NIH, while procedures of an experimental nature are likely to receive continued research support. In this regard, grant review committees can serve an important, although not obvious function in determining the status of a procedure. For example, if funds for the clinical care of

patients are rejected upon grant review, the implication is that the procedure is no longer experimental. Therefore, support is to be sought elsewhere for the clinical care of patients. This source of support, quite surprisingly, is usually either public or private insurers.

With these few basic points in mind, the primary objective of this chapter is to demonstrate the utility of the distinction between experimental and therapeutic procedures. As noted, however, I believe a rigid distinction between the two is unsatisfactory. Medical science is best conceptualized as a continuum with two poles. At one end are procedures that are highly experimental and questionable and at the other end are procedures that are widely acceptable and as such are regarded as therapeutic.

B. PROGRESS IN MEDICAL SCIENCE

Progress in medical science begins in the laboratory and culminates in the practiticing physician's office or the hospital. Thus, it is not surprising that the experiment-therapy dichotomy persists despite evidence in favor of a continuum approach. Chapters 3 and 4 of this report traced the early history of both renal and heart transplantation to demonstrate the difficult and uncertain periods surgeons endured before they were able to first demonstrate the feasibility of their treatment approach and then to justify its use in very sick human beings. Animal studies are clearly the benchmark of experimental procedures, while initial clinical applications in humans constitute the first sign that a procedure is

gaining acceptance as therapy. Swazey and Fox (1979:347) have characterized progress in medical science as follows:

> ...one sees a process of therapeutic innovation which generally progresses from animal experiments to clinical trials with terminally ill patients beyond conventional therapeutic help, to the use of the treatment on less and less critically ill patients.

As progress is made, for instance in the case of liver transplantation recently, a primary consideration is just how "less" critically ill a patient must be before they undergo a procedure. In the case of liver transplantation, it is clearly recognized that the sicker the patient, the less favorable the outcome. But at the same time, a considerable risk is incurred in performing a procedure such as a liver transplant and it is generally felt that the procedure should be performed only when the patient has no hope of recovery from their disease, that is, when they clearly have end-stage liver disease with a prognosis of imminent death. Thus, the medical and surgical team with responsibility for the management of the patient with end-stage liver disease is confronted with a situation of conflicting demands. If they operate too late, the patient may not recover and subsequently die. If they operate too early, the hope is that the patient will recover, but a complication encountered during surgery may result in the premature death of the patient. And so it is with many surgical procedures or technological innovations that are in the early stages of development.

Humans involved in initial experiments with new surgical procedures undergo enormous risks. They are little more than "Guinea

pigs." They have volunteered, hopefully with informed consent, to serve as the subjects of human experimentation. Their motivation may be laudable, as in the case of Dr. Barney Clark, the recipient of a totally implantable artificial heart at the University of Utah (Jarvik, 1981; DeVries et al., 1984), or it may be self-serving, as in the case of individuals who seek the publicity and notoriety to be gained by agreeing to be the subject of highly visible medical experimentation. Whatever the motivation, in the end society owes a great debt not only to those medical professionals who have endeavored to perfect a treatment, but to the subjects who have been willing to subject themselves to "experiment perilous" (Fox, 1959). The whole enterprise of medical experimentation amounts to high stakes gambling. On the one hand, the patient/subject's life hangs in limbo, while, on the other hand, the physician-investigator has a reputation with which to be concerned. The physician who takes what his colleagues may feel are unwarranted risks is likely to become the victim of their consternation. He may also, in the extreme case, find himself in a court of law defending his actions if proper patient consent was not obtained prior to embarking on an experimental procedure.

It is with regard to the foregoing that Swazey and Fox (1979:350) have found the role of the physician-investigator to be particularly difficult. From an ethical viewpoint the physician-investigator must always be concerned about the fate of his patient, but from the scientific viewpoint he recognizes that certain sacrifices must inevitably be made. Swazey and Fox (1979:350-351) have characterized

the stressful situation in which the physician-investigator is embedded as follows:

> For all its intellectual, professional, and humanitarian gratifications, the role of research physician is accompanied by characteristic problems and stresses. [In particular they are] problems of uncertainty such a physician encounters, resulting from limitations in medical knowledge and practice at a given time. To these may be added those uncertainties that are artifacts of the inability of any physician personality to command all available medical knowledge and skill. Furthermore, the research physician deliberately works in the realm of the uncertain, focusing on those questions which medicine still has not answered, seeking to make some headway with their solution.

Most characteristic of the patients the physician-investigator treats is their inability to fully recover from the treatment they receive. In many regards, the physician-investigator at the cutting edge of medical science is offering what Lewis Thomas (1974; 1977) has appropriately referred to as "halfway technologies." The hope is that these halfway technologies will at least lead to substantial improvement in the overall prognosis of the patient or, better yet, that they will eventually be replaced with a cure.

If initial attempts to apply a new procedure clinically are met with failure, Swazey and Fox (1979:351) describe the situation as being ripe for a "clinical moritorium." This also occurs when "the role strains associated with clinical experimentation become acute and especially burdensome." In other published work Fox and Swazey (1974) and Swazey and Fox (1979) have described at length how and when a clinical moratorium occurs. They have used kidney dialysis, kidney transplantation, heart transplantation, and surgery for mitral

stenosis as primary examples. Swazey and Fox (1979:358) are cautious in their description of a clinical moratorium. They say, for example:

> ...a moratorium does not mean a permanent abandonment of a therapeutic innovation, either because it has proved to be unfruitful or noxious, or because, in the natural flow of medical scientific advance, it has been superseded by a better one. Nor, according to our definition of the phenomenon, does the failure to move from the level of animal to human trials constitute a clinical moratorium.

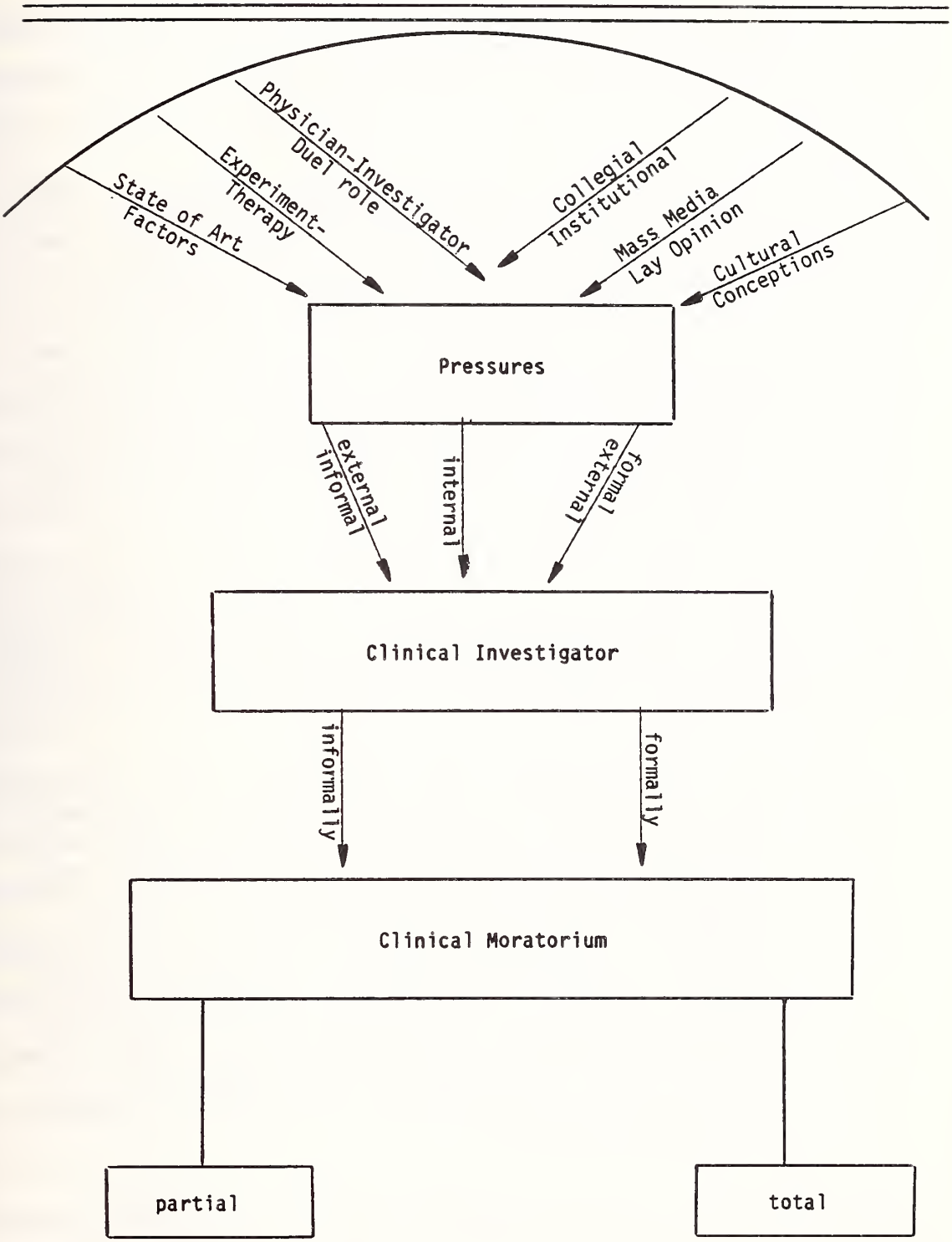
Fox and Swazey (1979) have offered the schema shown in Figure 42-1 as the process "through which a moratorium comes to be called." They state that the pressures toward calling a moratorium can logically and empirically take a variety of different forms.

As described here, progress in medical science follows an uncharted course. There are few signposts to assist clinicians, their patients, and policymakers as to when questionable procedures become acceptable and thus are entered as a part of the standard medical armamentarium available to treat diseases. Both patients and physicians in the early phases of medical experimentation incur great risks--the health of the patient may be further jeopardized and the professional status of the physician-investigator may be undermined. Nonetheless, the objective of all research, despite its risks, is to facilitate progress.

C. STATISTICAL PROBABILITIES AND THE "INDIVIDUAL DEATH" AS EVIDENCE OF THE THERAPEUTIC STATUS OF A PROCEDURE

Progress in medical science, as in all science, is clearly uneven, but there are methods by which "progress," loosely defined, can be

Figure 42-1
Initiation of a Clinical Moratorium



hastened. Fletcher (1969) has described at some length the factors that determine when experimental or laboratory procedures are applied in the clinical setting. Swazey and Fox (1979:348) have drawn upon Fletcher's work to describe this process as follows:

> In order to evaluate what constitutes the justifiable use of a new medical procedure and appraise "success" and "failure," physicians characteristically make what Joseph Fletcher has termed "mathematicated decisions" based upon a "statistical mortality." They estimate and express in terms of probabilities and percentages the differential diagnosis of a disease, and its course under different circumstances, especially its prognosis to alternative treatments. This way of reasoning is not peculiar to the clinical investigations; rather it is inherent in all medical practice."

Swazey and Fox (1979) then go on to use mitral valve surgery as an example of how probabilities are used to justify a course of action. Again, a lengthy quote is appropriate for demonstrating this approach.

> We have noticed that after his first four valvulectomies Cutler acknowledged that a 75 percent mortality rate is "alarming," but maintained that in terms of each case it is not "disastrous," and affirmed that his results must be judged in comparison with other pioneering surgical efforts--mortality rates of 65 to 81 percent were long common in surgery "of such a relatively simple field as that of the stomach." Similarly, in his "Final Report" of 1929, Cutler insisted that "the mortality figures (90 percent) alone should not deter further investigation...since they are to be expected in the opening up of any new field for surgical endeavor."

Swazey and Fox (1979:348) acknowledge that still another form of "statistical mortality" can be used to rationalize the treatment of

critically ill patients. In this case, it is argued that if all available conventional therapies have been tried unsuccessfully, then without the new therapy the patient would die anyway. Again this was an argument used for operating on Class IV mitral stenotics. Swazey and Fox (1979:349) comment on this as follows:

> ...Brunton argued that "the risk of a shortened life" without heart surgery should be balanced against "the certainty of a prolonged period of existence which could hardly be called life" with surgery.

The point being made here is well-taken and doubtlessly motivates many physician-investigators to undertake procedures that may have otherwise been considered to be questionable at the time they were attempted. Certainly this was true of Barnard's first heart transplant at Capetown (Barnard and Pepper, 1969).

While the notion that statistical probabilities are the basis for difficult decisions concerning medical experimentation, there is evidence that the "individual death" can serve as the basis for justifying the use of procedures that have not been declared therapeutic. Over the past year, for example, when several noteworthy figures in the transplant community have been asked whether liver transplantation is experimental or therapeutic, an appeal is frequently made to survivors of the procedure as solid evidence that the procedure is therapeutic. This, despite the fact that patient survival rates are around 30 percent at one year (Scharschmidt, 1983). At the recent (June 20-23, 1983) National Institutes of Health Consensus Development Conference on Liver Transplantation such an

appeal was frequently made by Dr. Thomas Starzl (University of Pittsburgh) and other proponents of the procedure. In fact, at the entrance to the auditorium where the conference was held, a poster board prominently displayed pictures of the survivors of liver transplants. The message, although unwritten, was clear: "Liver transplantation is therapeutic." The Consensus Panel, however, was more modest in its conclusion which, in part, read as follows (Consensus Conference, 1983:1964):

> After extensive review and consideration of all available data, this panel concludes that liver transplantation is a therapeutic modality for end-stage liver disease that deserves broader application. However, for liver transplantation to gain its full therapeutic potential, the indications for and results of the procedure must be the object of comprehensive, coordinated, and ongoing evaluation in the years ahead. This can best be achieved by expansion of this technology to a limited number of centers where performance of liver transplantation can be carried out under optimal conditions.

Nonetheless, the appeal to the survivors of liver transplants profoundly impacted upon members of the lay community and the mass media that attended the conference.

Granting a procedure therapeutic status implies that resources will be allocated to facilitate its diffusion. Previously I have outlined the essential ingredients and the process by which resource allocation and rationing decisions are likely to be made in the health care field. In doing so, I underscored the importance of the distinction between an individual death/life and a statistical life/death (Evans, 1983a; 1983b). These concepts were introduced by

Schelling (1968) in his analysis of how public resources are allocated. They are applicable to the analysis of the use of patient survival as evidence that a procedure is therapeutic. It is hard to deny that something "works" when a living patient is standing before you. As Schelling (1968) has argued, it is difficult to deny this evidence when deciding how resources will be allocated. The approach, however, ignores the masses in favor of the individual. Schelling (1968) provides the following example to illustrate his point:

> Let a 6-year old girl with brown hair need thousands of dollars for an operation that will prolong her life until Christmas, and the post office will be swamped with nickles and dimes to save her. But let it be reported that without a sales tax the hospital facilities of Masscahusetts will deteriorate and cause a barely perceptable increase in preventable deaths--not many will drop a tear or reach for their checkbook.

The related point being made here is simple: statistical probabilities may propel physician-investigators to attempt new surgical procedures but when a decision must be made about the experimental or therapeutic nature of a procedure and, hence, how public resources will be allocated, public sentiment in favor of the latter can easily be mustered by appealing to the individual life-saved.

The problem with such emotional appeals is that they are hardly rational. For example, what about the 70 or 80 percent of the people who fail to survive a procedure that is actually questionable? The problem, indeed, is a critical one and it has become more critical as the public funds devoted to research have become increasingly scarce.

Intense pressure is now being placed on public and private insurers to pay for procedures that barely qualify as therapeutic. Many are still in the developmental phases, yet the available research funds are of short supply and if physician-investigators want to practice their craft, they feel the need to make premature claims to justify their actions and to gain funding support to continue them. This, of course, brings me to my next point, the relationship between research support and the status of experimental procedures.

D. RESEARCH FUNDING AND THE EXPERIMENT-THERAPY DILEMMA

While the emotional appeal to individual life-saving efforts generates considerable public and political support for the most highly visible of new technologies, a more subtle transformation is occurring within the research community that will clearly alter our thinking on experimental procedures. Over the past 10 to 15 years there has actually been a gradual decline in the support of biomedical research in the United States (Kahn, 1984a; 1984b; Wagner and Boykin, 1983; Evans, 1983a). Kahn notes that this is true whether support is considered in terms of constant dollars or the fraction of total health-care costs devoted to research. In 1970 about 3.9 percent of all health care dollars were devoted to research and development, whereas by 1982 the figure had declined to only 2.9 percent, or $9.2 billion for research and development, as compared with a total health-care budget of $317 billion (Wagner and Boykin, 1983).

With the foregoing in mind, the rub is essentially this: as those responsible for the allocation of research funds are faced with

smaller and smaller budgets, they will, in effect, make decisions concerning when experimental procedures become therapeutic. The tendency will be to err on the side of making questionable procedures acceptable. The criteria for doing so will most probably be survival but could also include considerations such as quality of life. Why must administrators of organizations that fund research make such decisions? The answer is simple if we recognize there are more research priorities than can be comfortably afforded within existing budgets of the sponsors of research. Thus, maximizing the use of available resources, the tendency will be to declare procedures acceptable or therapeutic at an earlier point in their development. This will, in effect, permit the sponsors of research to rearrange their research priorities. As a result, research administrators are able to satisfy the demands made on them by showing that they have supported research that has been fruitful, however defined. The object, of course, will be to support more projects that will advance medical science in other related areas. Ultimately, therefore, progress in medicine is evidenced by previously questionable procedures becoming acceptable. The problem, however, in the case of experimental procedures, is that the available research support is not likely to be sufficient to fully develop them.

The outcome of this complex process is clear: grant review committees and research administrators will, by default, become increasingly responsible for deciding when a procedure is experimental or therapeutic. While this may be acceptable, it by no means represents the most rational approach to addressing the difficult

issues associated with the experiment-therapy dilemma. There will be a tendency to pass the issue off to public and private insurers prematurely. It would seem, therefore, that another approach is required. For example, comprehensive technology assessments could be periodically undertaken, not only to ascertain the status of a questionable technology but to set research priorities associated with those technologies in question. A number of proposals have been offered to accomplish such a task (Bunker et al., 1982a; 1982b; Perry, 1982a; 1982b; Sun, 1983). Another approach might be to increase the funding available for conducting research. In this regard, Kahn (1984a) has offered a proposal that would involve the private insurance industry. In support of his proposal, Kahn (1984a) notes, for example:

> ...the federal government contributes about one-third of all health-care dollars in the form of Medicare and Medcaid payments and about 54 percent of the funding for research. Blue Cross-Blue Shield, in contrast, contributes one-third of the total health-care dollar but virtually nothing for research.

Overall, the response to Kahn's proposal has been positive (Applquist, 1984; Jako, 1984; Linkner, 1984; Luke RG 1984; Rosenzweig, 1984; Kahn, 1984b).

Clearly, therefore, there are at least two approaches that can be followed to head off the inevitable and poorly planned premature declaration of questionable procedures as acceptable. The failure to remedy the current situation will greatly hinder progress in biomedical research and put an increasingly large number of patients in the

category of research subjects and a growing number of physicians in the category of physician-investigators. Unfortunately, it is also likely that the number of halfway technologies that become available to clinicians will increase markedly over the next decade.

E. A PROPOSAL TO RESOLVE THE EXPERIMENT-THERAPY DILEMMA

It is my contention that the experiment-therapy dilemma can be resolved on a case-by-case basis. The approach I propose is relatively straightforward and would involve a modest investment in the exercise of health care technology assessment. I believe there are several clearcut gains to be achieved by resolving the experiment-therapy dilemma. They are: (1) it is possible to determine at precisely what point a procedure becomes acceptable according to a standard protocol using standard criteria, (2) it is possible to assist public and private insurers in the exercise of making coverage determinations (Towery and Perry, 1981; Greenberg and Derzon, 1981), and (3) it is possible to assist agencies that fund research in setting appropriate research priorities.

Before describing this simple approach, it is important to recognize the following: (1) A continuum underlies the distinction between experimental and therapeutic procedures. I use the terms questionable and acceptable to underscore this point. (2) A procedure that is therapeutic today may not be so tomorrow. If significant medical progress is made, it is quite possible that a procedure that has been declared acceptable or therapeutic can be down-graded to questionable. Thus, the status of a procedure is always subject to

change and any changes can be made on the basis of competing evidence. (3) Finally, cost should not be a consideration in deciding whether a procedure is experimental or therapeutic, at least initially. Experiment-therapy judgments are essentially medical-technical. Cost should be a consideration only at the time policymakers are forced to make resource allocation decisions (Evans, 1983a; 1983b).

I now present a general but simple approach to resolving the experiment-therapy dilemma. Having done this, I will return to a discussion of each of the three foregoing points. They are essential to an understanding of how the findings produced by my approach can be applied.

Medical technologies, of which surgical procedures are a single example, do not exist in a vacuum. They are a part of the repertoire of medical practice. Most importantly, even though vastly different treatment approaches are applied to patients with vastly different health problems, an element of comparability exists. This comparability, essential to deciding whether a procedure is acceptable or questionable, may amount to little more than being able to describe a procedure as complex, difficult, or simple. For example, in the treatment of mitral stenosis we found that one pioneering surgeon in describing his own efforts noted that he judged his failure/success in terms of other procedures including surgery involving the stomach. What this implies is conceptually straightforward. We always locate a suitable benchmark for determining a rate of success or failure. Thus, in resolving the experiment-therapy dilemma it would appear

prudent to compare a questionable procedure with one that is of equal complexity but has been found acceptable and may have achieved therapeutic status. For example, to determine if heart transplantation is therapeutic, kidney transplantation would be, from my perspective, a good "reference therapy." Although a heart transplant is in some respects more difficult technically, it still has a great deal in common with kidney transplantation.

The resolution of the experiment-therapy dilemma, therefore, is quite simple and requires agreement on a benchmark that I refer to as a "reference therapy." Agreement must also be reached on the "reference criteria" that can be used to judge the status of a questionable procedure. Determining the reference therapy may be the most difficult task facing those who must determine the status of a procedure. It is noteworthy, however, that more than one reference therapy can be identified if agreement cannot be reached on only one. For example, it could be argued that heart transplantation can be compared with other forms of life-saving therapies such as kidney dialysis. In short, while kidney transplantation may be the first choice as a reference therapy, another life-saving procedure may also be included, at least initially.

As noted above, the next step in the assessment process involves the identification of the appropriate reference criteria that are critical to the acceptance of the reference therapy. The same outcomes must be used for both the reference therapy and the questionable procedure. Clearly, in the case of life-saving procedures, patient survival is one outcome of interest. But, as

noted above, quality of life may also be a consideration.

At the outset of the assessment process, it must be recognized that data for the identified reference criteria must be available for both the reference therapy and the questionable procedure. These data must be directly comparable or the assessment process will necessarily be faulty. If the assessment process is faulty, a consensus cannot be reached.

Having agreed upon the reference therapy and identified the appropriate reference criteria, the necessary assessment steps can be taken to resolve the experiment-therapy dilemma for a given procedure at a particular point in time. In making the assessment, the criteria are evaluated objectively, there is no appeal to emotions, and the determination can be made with minimal time and effort, provided suitable data are available on the reference criteria. Below this approach is applied to the assessment of heart transplantation.

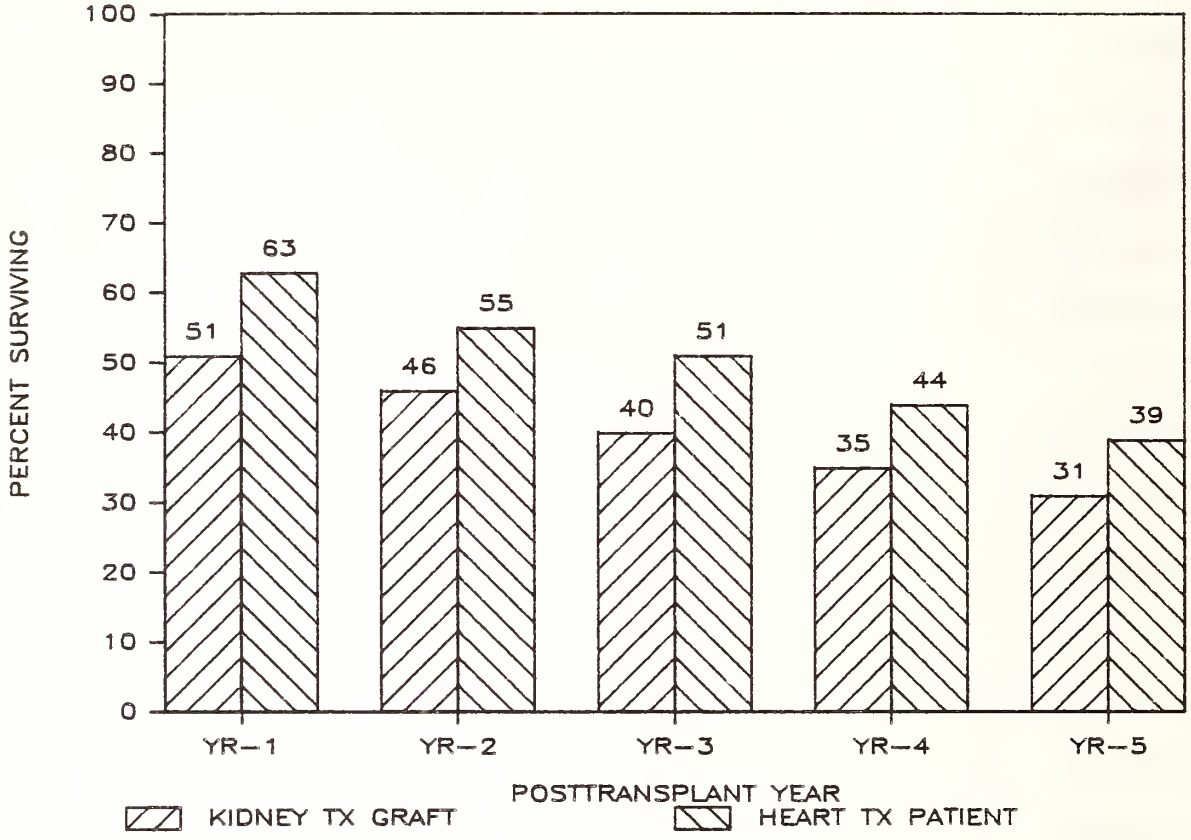
In a recent letter to the editor of the Lancet, a leading medical publication in England, I compared the survival of heart transplant recipients with that of kidney transplant recipients (R.W. Evans, 1984). In a previous letter to the editor, a question had been raised about the funding of heart transplants by the National Health Service (D.W. Evans, 1984). In the letter cardiac transplantation was criticized as a misallocation of resources. The author contended that the resources allocated to cardiac transplantation could be better spent on the "routine cardiac surgical service." In my letter I noted that this criticism had merit, but I argued that the question concerning resource allocation pointed out a serious problem in

determining when a surgical procedure has therapeutic value rather than mere potential. I further noted that in the United Kingdom, and in the U.S., renal transplantation has long been considered efficacious treatment for patients with end-stage renal disease. As a basis for debating the merits of heart transplantation, I compared cadaveric kidney graft and heart transplant patient survival rates in the U.S. for patients on conventional immunosuppressive therapy. I argued that except for the rare occasion upon which cardiac retransplantation is performed, it is more appropriate to compare cadaveric kidney graft with heart transplant patient survival rather than kidney transplant patient with heart transplant patient suvival (Pennock et al., 1982; Kraukauer, 1980). The graph accompanying my letter is reproduced here as Figure 42-2. As shown, when this comparison is made, heart transplantation is actually superior to kidney transplantation. I concluded my letter to the Lancet as follows: "Clearly, if survival (the reference criterion in this case) is the issue, heart transplantation is on equal footing with renal transplantation."

Based on the foregoing, therefore, if renal transplantation were chosen as one reference therapy and survival as one "reference criterion," heart transplantation would be considered therapeutic because kidney transplantation is considered accepted therapy. While this example illustrates a point, I must concede that the use of a single reference criterion to judge a procedure is unsatisfactory. It is important to use as many criteria as possible within the constraints of available data. The more evidence that is accumulated,

FIGURE 42-2

GRAFT AND PATIENT SURVIVAL RATES



the less likely a decision concerning a questionable procedure will be controversial. Thus, let me now consider quality of life as an additional reference criterion. Rather than use a single quality of life indicator, I have chosen to use a multiple indicator approach.

In Chapter 26 we compared the quality of life of heart transplant recipients with that of kidney transplant and renal dialysis patients. One table from that chapter is reproduced here as Table 42-1. Based on the results presented in Table 42-1, we must conclude that on all quality of life indicators, except the Karnofsky Index of functional impairment, heart transplant recipients do more poorly than kidney transplant recipients. Consequently, we would find it difficult to argue that heart transplantation is on a par with renal transplantation. On neither objective nor subjective quality of life indicators are heart transplant recipients comparable with renal transplant recipients. Our analysis should not be concluded at this point, however. If we choose renal dialysis as an alternative or second reference therapy, we find that heart transplant recipients have quality of life outcomes that are similar to those of home hemodialysis patients and are actually superior to those of in-center hemodialysis patients. Moreover, the survival rate of heart transplant recipients actually exceeds that of hemodialysis patients (Krakauer et al., 1983; Vollmer et al., 1983). Thus, if renal dialysis were regarded as an acceptable reference therapy, we would conclude that heart transplantation is therapeutic.

There are obviously several problems associated with my approach to resolving the experiment-therapy dilemma. First, reaching a

Table 42-1
Summary of Quality of Life Scores For All Patient Groups

PATIENT GROUP		UNADJUSTED OBJECTIVE INDICATORS OF QUALITY OF LIFE			UNADJUSTED SUBJECTIVE INDICATORS OF QUALITY OF LIFE		
		FUNCTIONAL IMPAIRMENT[1]	ABILITY TO WORK[2]	HEALTH STATUS[3]	WELL-BEING[4]	PSYCHOLOGICAL AFFECT[5]	LIFE SATISFACTION[6]
HEART TRANSPLANT RECIPIENTS	$\bar{X}$	1.47	57.88	9.60	11.11	5.49	5.11
	S.D.	(.772)	(49.55)	(9.01)	(2.53)	(1.32)	(1.28)
KIDNEY TRANSPLANT RECIPIENTS	$\bar{X}$	1.96	74.13	5.52	11.83	5.62	5.66
	S.D.	(1.30)	(43.95)	(7.06)	(2.72)	(1.25)	(1.62)
HOME HEMODIALYSIS PATIENTS	$\bar{X}$	2.56	59.30	9.53	11.12	5.42	5.19
	S.D.	(1.19)	(49.21)	(9.13)	(2.67)	(1.20)	(1.56)
IN-CENTER HEMODIALYSIS PATIENTS	$\bar{X}$	3.11	37.20	13.89	10.77	5.15	5.11
	S.D.	(1.57)	(48.40)	(11.24)	(2.73)	(1.31)	(1.69)
CONTINUOUS PERITONEAL DIALYSIS PATIENTS	$\bar{X}$	3.01	24.69	13.69	11.05	5.24	5.30
	S.D.	(1.34)	(43.39)	(9.71)	(2.83)	(1.26)	(1.68)
ALL DIALYSIS PATIENTS	$\bar{X}$	2.88	44.68	12.16	10.94	5.27	5.16
	S.D.	(1.43)	(49.75)	(10.54)	(2.72)	(1.26)	(1.64)
GENERAL POPULATION	$\bar{X}$	N/A	N/A	N/A	11.77	5.68	5.45
	S.D.	N/A	N/A	N/A	(2.21)	(1.12)	(1.25)

[1]Based on the Karnofsky Index, range of values = 1.0 to 10.0 where 1.0 = absence of dysfunction and 10 = maximum dysfunction (death).

[2]Ability to work, range of values = 0.0 - 100.0, where 0.0 = patients unable and 100.0 = patients able.

[3]Total Sickness Impact Profile score only, range of values = 0.0 - 100.0. Lower scores indicate better health status.

[4]Range of values = 2.1 to 14.7 where high score = positive well-being.

[5]Range of values = 1.0 to 7.0 where 7.0 = positive affect.

[6]Range of values = 1.0 to 7.0 where 7.0 = positive satisfaction.

consensus on appropriate reference therapies is difficult. Here I initially chose kidney transplantation as my first choice reference therapy. After examining various reference criteria I then chose a second reference therapy--renal dialysis. Renal dialysis, like kidney transplantation, is considered acceptable therapy for end-stage renal disease. It too, is a life-saving approach to a terminal condition. However, it could be argued that renal dialysis is not a good reference therapy for heart transplantation. I agree that there is some truth to this, but do not intend to resolve this problem within the space of this chapter.

A second problem with my approach concerns inconsistencies that arise when a variety of reference criteria are examined. In terms of survival, heart transplant recipients compared favorably (actually were superior to) kidney transplant recipients. But on most quality of life indicators the two patient groups are not comparable. Again, I note that this is a problem but perhaps it can be resolved by arranging the reference criteria in some priority order. If there are inconsistencies on lower priority reference criteria, this may be a source of less concern.

Finally, my approach can be criticized because it is unclear as to what extent the reference therapy and the questionable therapy can differ on the reference criteria and still be considered comparable. For example, are small differences in patient survival and quality of life unimportant? This issue can be potentially resolved by applying appropriate statistical tests, but in some instances substantive

rather than statistical significance may be the real issue. Again, I am unable to offer a definitive solution to this problem.

Now I will digress slightly to illustrate how my approach, despite its problems, is useful for resolving the experiment-therapy dilemma by shedding additional light on the issues. Without question, liver transplantation has complicated a decision on the current status of heart transplantation. Over the past year liver transplantation has gained considerable attention both within the medical profession and among the lay public. As a result, liver transplantation has been declared therapeutic by some private insurers. In a rather surprising move, Assistant Secretary of Health, Dr. Edward Brandt, has declared liver transplantation therapeutic in children with biliary atresia and other rare congenital abnormalities. The Department of Health and Human Services now finds itself in the difficult position of dealing with adult liver transplantation as a separate case. If the approach I have described for resolving the experiment-therapy dilemma were applied to heart transplantation, with liver transplantation chosen as the reference therapy, there is absolutely no question that heart transplantation would be granted therapeutic status. On every possible reference criterion, heart transplantation is superior to liver transplantation. However, if heart transplantation was ruled therapeutic and liver transplantation was the procedure in question, it would be <u>unlikely</u> that liver transplantation would be granted therapeutic status. On no reference criterion does liver transplantation equal heart transplantation.

Now I will return to the three points that were made prior to the elaboration of my approach to ascertaining the status of heart transplantation. My first point was that a continuum underlies the distinction between experimental and therapeutic procedures. The reference criteria we choose to assess procedures emphasizes this aspect of the experiment-therapy resolution process. Even our choice of reference therapies underscores the continuum aspect of this approach.

My second point was that the status of a procedure can change over time and this change can be in either direction. A procedure that has once been declared experimental may, upon reevaluation be declared therapeutic. Also, however, a procedure once ruled therapeutic may be down-graded to questionable status, or even ruled obsolete. For example, if a significant breakthrough occurs that brings into question the status of a procedure that was previously granted therapeutic status, the procedure must be reevaluated. Upon reevaluation, the procedure may lose its therapeutic status. In addition, any procedures that had been previously judged therapeutic on the basis of the reevaluated procedures' former status must also be reevaluated since they may no longer constitute accepted therapy. Progress in biomedicine is not well-represented by a straight line, but may follow a circuitous route. Our assessment of medical procedures must take this into account.

The foregoing element of change means that, in the long-term, the status of any procedure is uncertain. It is precisely this element that can eventually be used to upgrade our expectations in medicine.

For example, it is conceivable that a procedure such as renal dialysis could be down-graded if we chose a reference therapy that is of a higher standard than that used previously. Ultimately resource allocation decisions may lead us to expect more from medicine. To accomplish this, we may choose reference therapies that yield a higher rate of return. In effect, we may eventually make it more difficult for a questionable procedure to gain acceptable or therapeutic status. By doing so, we are less likely to confront exceedingly difficult resource rationing problems.

The last of three points I made previously has just been alluded to, that being the role of cost considerations in the resolution of the experiment-therapy dilemma. I argued that, at least initially, cost should be excluded as a criterion in the rendering of an experiment-therapy judgment. I noted that such judgments are essentially medical-technical. At some point, however, it is true that difficult decisions must be made as to how society will allocate its resources. It is precisely at this point that cost will in part dictate which medical procedures are therapeutic. The question confronted by policymakers might be, of these accepted therapies, which can save the most lives at the least cost? In a sense, therefore, cost does not dictate which procedures are therapeutic--it simply forces us to decide which of the available therapies is most worthy of public support.

Ultimately, the approach described here for resolving the experiment-therapy debate also has very significant implications for the application of cost-benefit and cost-effectiveness approaches to

the allocation of societal resources. My approach removes certain unattractive features from the process of making difficult decisions about medical procedures. Clearly, the less that cost enters into such decisions, the more palatable the outcomes will be to the public.

F. CONCLUSION: IS THE DILEMMA WORTH THE DEBATE?

I now conclude this Chapter by drawing upon the work of a highly regarded sociologist who has been a keen observer of what he refers to as the "career of medical innovations." McKinlay (1981) has offered a framework for understanding how medical innovations, such as heart transplantation, become a part of established medical practice. He suggests that any innovation will pass through seven stages, although not always linearly. These stages are as follows: (1) the stage of the "promising report," (2) the stage of professional and organizational adoption, (3) the stage of public acceptance and state (third-party) endorsement, (4) the stage of "standard procedure" and observational reports, (5) the stage of the randomized controlled trial, (6) the stage of professional denunciation, and (7) the stage of erosion and discreditation. It is worth more closely examining these seven stages to anticipate what may happen in the future to a procedure such as heart transplantation.

At the stage of the promising report minimal data have accumulated although the data that are available provide a very positive outlook on a new innovation. The mass media closely observes these new developments frequently reported in the letters to the editor section of medical professional journals or at the annual meetings of

professional associations. Case-studies in medical journals are also a source of initial information on a procedure that is believed to hold promise for the future. The problem with these reports is that the studies on which they are based are usually "...severely limited and can most appropriately be included in the category of uncontrolled observational reports" (McKinlay, 1981:380).

In the field of heart transplantation the initial reports were published in the late 1960s and 1968 was a watershed year, as many teams throughout the world performed one or more transplant procedures. But as so eloquently described by Fox and Swazey (1974), a moratorium was declared and with the exception of the teams at Stanford and the Medical College of Virginia, heart transplant activity all but ceased. As of late, actually beginning in 1980, heart transplantation has met with renewed enthusiasm, largely due to the new immunosuppressive agent cyclosporine. In effect, cyclosporine is itself a new innovation that has spurred much interest in organ transplantation. Although not the "magic bullet" some have portrayed it to be, we have once again been exposed to a large volume of "promising reports," perhaps best illustrated by successful attempts to transplant hearts in pediatric patients, one of which was four years old (Columbia Presbyterian Hospital, New York) and another that was two years old (University of Michigan). Because of these promising reports, we now estimate that over the next five years, as many as 91 institutions may initiate heart transplant programs (see Chapter 39).

The second stage in the career of a medical innovation is that which I have just alluded to--professional and organizational adoption. During this second stage more widespread and influential support is mobilized. McKinlay (1981:381) argues that at this stage professional adoption usually involves an investment (resources, time, reputation). It differs from public acceptance.

There are undoubtedly many factors that motivate adoption of new procedures. They may include professional and institutional prestige, the likelihood of economic gain, an attempt to regain patients that are now being treated by more effective means than practiced in the past, and an opportunity to supplement medical education goals.

Again heart transplantation has not been exempt from this stage in its career. Many cardiovascular surgeons are highly committed to the procedure and see a considerable benefit for the patients they treat. Some, however, are now confronted with a situation of reduced patient caseloads as patients that have formerly received bypass procedures may now be medically managed nearly as effectively as surgery. Thus, heart transplantation is viewed, in the words of some, as a new "gimmick" to replace lost patients. Still other surgeons are encouraged by their institutions to embark on heart transplant programs because of the prestige that such a program bestows on the institution. Finally, heart transplantation is just one in a series of developments in the management of patients with cardiovascular disease and not offering the procedure may lead the public to question just how "good" the institution is.

This brings us to the third stage, that being the stage of public acceptance and state (third party) endorsement. As McKinlay (1981:385) notes, "Partly because of exposure to promising reports (Stage 1), but mainly as a result of professional and organizational adoption (Stage 2), a general approval (acceptance) of the innovation emerges among the public." People gradually come to view the innovation as a "good thing," and expect that it would be available when they or someone they know may require it. Medical professionals can do much to muster public support for their activities. Above, I have described how the plea to the individual death can do much to change the public's mind about a questionable procedure such as liver transplantation.

Endorsement of a procedure usually becomes apparent as third party payers change their policies to include reimbursement for the procedure. For example, if Medicare pays, it is generally accepted that the procedure has therapeutic value. Private insurers, in turn, often follow the lead of the Medicare program. At this point in the career of an innovation there may be much expert testimony, Congressional and otherwise, about the value of a procedure but as McKinlay (1981:386) notes, "...an innovation at this highly public third stage in its career usually remains without formal evaluation."

This has been especially true of heart transplantation. The Stanford group has produced a very impressive array of statistics from patient survival to quality of life, but the question remains to be answered as to just how well other groups can duplicate the Stanford track record. Initial reports are favorable from other heart

transplant centers, but these centers are unlikely to be representative of those that may embark on heart transplantation over the next five years.

Gradually a time comes when new innovations undergo careful scrutiny, often after public support has been amassed. The National Heart Transplantation Study (Evans et al., 1982) represents one such effort. It is unfortunate, however, as McKinlay (1981:387) observes that" "A careful review of the early careers of many different innovations reveals that, more often than not, the step was in quite the wrong direction and wasted resources, diverted professional and organizational resources to unproductive activities, and misled the public" (also see Bunker et al., 1977).

The fourth stage in the career of an innovation is the stage of the "standard procedure" supported by observational reports. Through state endorsement and third party coverage an innovation receives the privileged status of a "standard procedure." At this point the reports on the new procedure tend to be highly biased and the enthusiasts become even more convinced of the value of their procedure. Few people may ask questions about the procedure as this will surely invite retaliation from professional organizational interests, public indignation, and in rare instances, sanctions from the state.

Many observational reports may accumulate on the new procedure, often exhibiting serious flaws. Four of these flaws McKinlay (1981:388-389) underscores as follows. First the state may attempt to do little more than justify a previously held position after it has

endorsed the procedure. Second, the groups who conduct the necessary studies may have a vested interest in uncovering a beneficial outcome for the innovation. Third, most observational studies have serious methodological flaws that necessarily undermine their value. For example, sample size may be inadequate, the procedure may have only been applied to a highly selected group, there may be no adequate comparison group, and subjective outcomes may be the only standards of comparison. Finally, "...although comparative observational studies sometimes provide useful information relating to the cost efficiency and social acceptability of an innovation, they seldom add much to knowledge concerning the effectiveness of the innovation in relation to the problem that it is designed to assist" (McKinlay, 1981:389).

The fifth stage in the career of a medical innovation, although highly desirable, is becoming increasingly impractical. This is the stage of the randomized controlled trial (RCT). An RCT is truly the means by which the effectiveness of a procedure can be demonstrated. The problem is that RCTs are expensive and in some instances impossible to conduct. For example, up until recently a great deal of contrary evidence had accumulated on the value of coronary artery bypass surgery (Chalmers, 1982; Murphy et al., 1977; Mundth and Austen, 1975a; 1975b; 1975c). The Coronary Artery Surgery Study (CASS) was undertaken in 1975 to answer the numerous questions concerning bypass surgery (Kolata, 1981; Principal Investigators of CASS and their Associates, 1981; CASS Principal Investigators and their Associates, 1983a; 1983b). The problem, of course, is that such studies are expensive and take many years to conduct.

Heart transplantation, however, poses us with a problem of impracticality. The procedure is only undertaken when all other methods of treatment have failed. Thus, the advocates of the procedure argue that it is impossible to do a RCT with heart transplantation. In the National Heart Transplantation Study we have at least attempted to partially resolve this problem by looking at patients who have been declared candidates for heart transplantation but have died while awaiting one (Evans 1983c; Evans et al., 1982). Consequently, a RCT may not always be an obtainable "gold standard."

The next stage McKinlay (1981:395) discusses is that of professional denunciation. This, of course, is the period during which a moratorium, as discussed by Fox and Swazey (1974), may be declared. RCTs are often denounced by advocates of a procedure subjected to evaluation based on methodological flaws that may be nonexistent. It is also true, however, that denunciation may occur before an RCT is even initiated. For example, if clinical results should take a turn for the worse, as heart transplantation did in 1968, people may begin to reject the initial enthusiastic reports. It is always difficult to estimate the strength of professional denunciation. RCTs may encounter stringent criticism previously withheld from observational studies, but groups may greatly force the issue by joining together to undermine every aspect of RCTs.

At this point in time heart transplantation is not being denounced and people are generally supportive of those who have pioneered the procedure and persevered through very difficult times. It may be, however, that if the procedure is attempted by inexperienced teams the

untoward outcomes experienced by patients may lead to denounciation by the medical profession. Many existing heart transplant programs are very concerned that we will see a repeat of 1968.

The final stage in the career of an innovation is the stage of erosion and "discreditation." McKinlay (1981:399) comments on this stage as follows:

> After some period of time (often more than a decade), and ever so gradually, an erosion of support begins to set in. The enthusiastic claims made for the innovation during its earlier stages are modified somewhat; it is not as universally applicable as once thought; it is useful only for certain groups of the population, or particular types or stages in an illness. Its career can sometimes be propped up for a while if it is combined with some other innovation or it may be relegated to the position of therapy for last resort--something to be employed after all other efforts are exhausted.

McKinlay's observations are interesting because they suggest that medical innovations go full-circle. The basis for employing a new procedure, as described above by Swazey and Fox (1979), is also the rationale that can be used to continue a practice that has been discredited. In effect, what is being suggested is that doing "something" is better than doing nothing, even though the procedure is known to have little to offer. In a sense, therefore, a discredited procedure is returned to the ranks of experimental treatment rather than completely abandoned.

Perhaps it is for this reason that there has been a renewed interest in heart transplantation. Once rejected by all but the most tenacious, the procedure has made a comeback. In this regard, rather than the experiment-therapy dilemma being characterized as a

continuum, perhaps it is best characterized as a circle. Clearly, as I have argued above, the status of any procedure is uncertain and it is this uncertainty that is the benchmark of medical progress.

I have now used McKinlay's (1981) framework to, in part, underscore some of my observations on the experiment-therapy dilemma. It is surprising that neither McKinlay nor Fox and Swazey appear cognizant of each other's work as their combined efforts have much in common when it comes to elucidating the experiment-therapy dilemma. In some respects I have attempted to bridge what I consider to be some serious gaps in our understanding of the experiment-therapy dilemma. I indeed feel the dilemma is worth the debate. I now conclude with a few observations on why I feel this is so.

First, I think we implicitly attempt to resolve in our own minds the experiment-therapy dilemma. I have attempted to provide an explicit framework for doing so. While the procedures I have described, that is, selecting reference therapies and deciding upon reference criteria may be unacceptable to some, I feel we have little choice but to confront the issue directly. The rules of the game should be stated clearly so all can participate.

Second, I think we must recognize that many, if not most, terminally ill people are willing to undergo any procedure or take any drug that reportedly has <u>life-saving potential</u> regardless of its <u>therapeutic value</u>. Drugs such as laetrile, for example, have perceived life-saving potential but their therapeutic value has not been demonstrated. Many procedures may offer a small and highly selected number of patients some life-saving potential, but when all

things are considered, the procedure may have little to offer the vast magnitude of people suffering the same disease or disorder. If we decide that all procedures should be exhausted in an attempt to save a life then, I think, we are only likely to encounter many more problems over the next several decades like those raised by transplant surgery. The experiment-therapy dilemma forces us to confront these issues regardless of how uncomfortable we may feel with them.

Third, I think we must be realistic in our expectations of medical research, and the resources we have available to devote to it. As I have noted above, funds available for medical research have become increasingly scarce and a larger number of scientists are competing for the dollars that are available. As a consequence it is becoming more difficult to practice medicine that is considered experimental. The National Institutes of Health, for example, seems to be more restrictive in making funds available for the clinical care of patients undergoing experimental procedures. The idea is to shift a greater share of the burden onto public and private insurers by declaring experimental procedures as therapeutic at an earlier point in their development. There I would hypothesize that if more funds were available for research organ transplantation would not be as highly visible as it is today. If transplant surgeons were able to go about their work with some assurance of funding, there would probably be a lot less pressure placed on insurers to pay for transplants. In the absence of funds, however, it has been imperative for transplant surgeons to seek support from what might be called "nontraditional" sources to permit them to conduct their research or as some might

prefer--to practice their art. Yet, public and private insurers have traditionally excluded what they consider to be experimental procedures from coverage. In effect we are seeing a trend where insurers are being asked to pay for research. This, indeed, is a strange sort of cost-shifting.

Faced with this dilemma, patients and surgeons appear to have entered into a pact to force the issue. Patients in need of transplants, and the public to which they appeal for assistance, appear to be convinced that a distinction between experimental and therapeutic medicine is of no value. Moreover, they see this distinction as the basis for their denial to medical care they are urgently in need of. Consequently, the public is both puzzled and inconsistent in their demands.

In the end I think it is useful to distinguish between medicine that is experimental and that which is therapeutic. It is unfortunate, however, that this distinction has not been uniformly applied in other areas of medicine. Why, for example, have organ transplant procedures been singled out for castigation? We must be able to make realistic distinctions indicative of progress in medicine. If we do not, then any physician may choose to apply and be reimbursed for any procedure that he or she feels has life-saving potential in the absence of demonstrated therapeutic value. Consequently, it appears to me that our desire to be successful by declaring any or all medical procedures therapeutic, in the end, will do little more than turn back the historical clock to a point where all forms of quackery and gimmickry will be considered to have

therapeutic value. This, I feel, would have disastrous consequences for medicine. We have gotten where we are today through fundamental scientific research. Why not continue this tradition of scientific excellence?

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CHAPTER 43

THE ARTIFICIAL HEART

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A. INTRODUCTION

On December 2, 1982, the first permanent total artificial heart was implanted into Dr. Barney Clark, a Seattle dentist. This event signaled a new beginning in artificial heart research. It renewed interest in an area that had been criticized by many as lavishly funded, yet unproductive (Caplan, 1982). Timetables as to when a viable heart would be available have always been optimistic, and milestones have passed with little concrete evidence that substantial progress has been made. For example, two observers in the field of artificial heart technology have noted that: "Today, after 15 years and over $180 million in Federal expenditures. ...a total implantable artificial heart is still a distant goal." These same observers have further commented that "The artificial heart program has received more Federal research money than the hemodialysis program did at equivalent stages of development." (Lubeck and Bunker, 1982b). Caplan (1982) has similarly underscored the thoughts of many commentators as follows: "Because of its failure to meet its own initial optimistic forecasts, the artificial heart program has been criticized by some scientists, scholars, and government officials as a paradigm case of misguided, "moonshot" medicine."

The history of the artificial heart has, indeed, been fraught with controversy. The first two implants were performed in 1969 and in 1981 by Dr. Denton Cooley. Strauss (1984:335) has commented on these two cases as follows:

> In 1969 and again in 1981, Dr. Denton Cooley of the Texas Heart Institute implanted an artificial heart in two patients in whom all conventional therapies had

> failed. The devices were intended to maintain support of life function until transplantation of a human heart was possible. Although in 1969 research was being performed in Dr. Michael DeBakey's laboratory at Baylor University with funding from the NIH, Dr. Cooley implanted the device without notifying either of these parties. In 1981 the law (through the Food, Drug, and Cosmetics Act and related amendments) clearly stated that any such use of an experimental device required an Investigational Device Exemption for the second implantation. Dr. Cooley did not obtain such an exemption for the second implantation, and the hospital was subsequently reminded of the proper legal procedures.

While one can be highly critical of activities such as those of Dr. Cooley and his coworkers, it should be recognized that pioneers are often criticized. The first step is always the most difficult, and not surprisingly, the most controversial. This brings to mind a quotation from Albert Einstein: "Great spirits have always encountered violent opposition from mediocre minds." If it were not for pioneers, it is likely that science, including the practice of medicine, would be a static rather than dynamic enterprise. Those who are willing to incur certain risks leave a mark on history that is not easily erased.

As the artificial heart signifies, heart disease is not always amenable to operative repair (Pierce et al., 1981b). While cardiac transplantation is available to selected patients with various severe forms of heart disease, there are several problems that preclude its use on a wide scale. They include donor heart availability, rejection of the allograft, and infection of immunocompromised host. As a result, the only alternative available to some patients is clearly some form of mechanical cardiac device (Lamberti and Resnekov, 1978; Pierce et al., 1981b; Pennock et al., 1982; Jarvik, 1981).

Over the past two decades a wide variety of cardiac assist devices have been developed and tested. Included among these are totally implantable units that have been transplanted in brain dead cadavers as well as human beings in the final stages of end-stage cardiac disease (Kolff, 1984; Jacobs, 1984; Watson, 1984; Cortesini, 1984). As noted by Jarvik (1981), the "concept of replacing the function of the heart with a mechanical device is far from new." As early as 1812, Julien-Jean-Cesar La Gallois noted that "if one could substitute for the heart a kind of injection (of arterial blood), one would succeed easily in maintaining alive indefinitely any part of the body." Early experiments with the total artificial heart were done in 1957 at the Cleveland Clinic by Dr. Willem J. Kolff and Dr. Tetsuzo Akutsu. These investigators continue to pursue the development of the artificial heart but have been joined by workers in many countries including Argentina, Austria, China, Czechoslovokia, France, Germany, Italy, Japan, the U.S., and the U.S.S.R. (Jarvik, 1981).

The primary objective of this chapter is to examine the implications of the artificial heart for the treatment of heart disease. We begin by describing the differences among devices that are currently available and the conditions that they are designed to treat. We then apply our technology assessment framework in an analysis of the artificial heart. We estimate the need for the artificial heart, look at factors that may limit its availability, examine the outcomes likely to be experienced by patients receiving the device, derive estimates of cost, and then consider key legal and ethical issues. It should be noted that with the exception of the

section describing the types of devices that are currently available, much of this discussion is highly speculative. As noted above, experience with the artificial heart is very limited. This minimal experience necessarily limits our analysis. Also, the devices that become available tomorrow may be unlike those available today. As a result, the implications may be different.

B. TYPES OF CARDIAC PROSTHESES

Jacobs and coworkers (1984) have suggested that there are several types of cardiac prostheses. They are: (1) transient, (2) interim, and (3) permanent. Each of these are described below:

Transient prostheses are used to support the temporarily failing heart and include intraaortic balloon pumping, cardiopulmonary bypass, and temporary left ventricular bypass, and temporary left ventricular assist or biventricular bypass devices. It is expected that the failed heart will regain function within a matter of several days to several weeks and that the assist device can be removed. It is hoped that the patient will recover and return to a normal life.

Interim prostheses are those that are used to tide a potential heart transplant recipient over until a suitable donor heart can be located. It is also possible that these devices could be applied in instances where a patient has rejected a transplanted heart and is in need of another. According to Jacobs and coworkers (1984), a variety of cardiac prostheses are considered interim. They include left, right, and biventricular bypass and also the total artificial heart.

These prostheses are only intended for use up to one month, although the Utah group believes this period could be extended to six months.

Finally, permanent prostheses are intended to be totally implantable for up to two years. These devices are still under development, but Jacobs and coworkers (1984:893) have high expectations for them noting that:

> ...only power transmission through the skin should be required for these systems. Twice a day, however, the patient should be able to function on his own for up to thirty minutes. Ideally, the implanted device should operate the system for at least 10 to 15 hours, with nocturnal recharging.

In 1982 Jacobs et al. (1984) estimated that a permanent left ventricular assist device is approximately three years away from clinical application.

Pierce has estimated the time frame within which various cardiac assist devices and an artificial heart may become available. Table 43-1 summarizes the availability of three devices--the temporary pneumatic artificial heart, the long-term implantable left ventricular assist pump, and the implantable motor driven artificial heart. It should be noted that during the 1970s as the National Heart, Lung, and Blood Institute assessed its artificial heart program, its orientation changed toward the development of devices for left ventricular assistance rather than total replacement (Strauss, 1984:335). Watson (1984:918) attributes the changed emphasis to the fact that "Research progress was slower than expected on implantable long-term devices, primarily because of a lack of scientific understanding and methods to

Table 43-1
Projected Use of Mechanical Circulatory Assistance
In Patients With Irreversible Forms of Heart Disease

	TEMPORARY PNEUMATIC ARTIFICIAL HEART	LONG-TERM IMPLANTABLE LEFT VENTRICULAR ASSIST PUMP	IMPLANTABLE MOTOR DRIVEN ARTIFICIAL HEART
0 - 5 Years	Available for short term use (to 60 days) in patients awaiting transplantation (Used twice by Denton Cooley, MD)	Not available	Not available
5 - 10 Years	As above	Available for patients not considered transplant candidates because of age over 50, pulmonary artery hypertension or associated disease	Not available
10 - 15 Years	As above	Direct competition with transplant in all categories of patients with left ventricular failure	Available for patients with biventricular failure who are over 50 years, pulmonary artery hypertension or associated disease
15 Years---	As above	As above	Direct competition with transplant for all patients with biventricular failure.

SOURCE: William S. Pierce, M.D. (1982), The Pennsylvania State University College of Medicine, Hershey, Pennsylvania 17033.

fabricate devices of appropriate size, physiological effectiveness, biologic compatibility, and required reliability."

Based on this discussion, it is clear that the artificial heart is a generic label applied to a variety of approaches to treating a failed heart. The failed heart may be a temporary condition or a condition that has reached end-stage. Also, the mechanical means to treat the failed heart reflect the nature of the heart condition. For example, the intra-aortic balloon pump can be used rather effectively to treat the patient with mild to moderate cardiogenic shock (Pennock et al., 1982). However, half these patients die from cardiogenic shock despite counterpulsation with the intra-aortic balloon (McEnany et al., 1978; Pierce et al., 1981). Therefore, Pierce and coworkers (1981) have employed a pneumatically powered ventricular-assist pump. Finally, in three cases a totally implantable heart has been used, in two of which the patients received heart transplants, and in the third, the patient survived 112 days.

This variability in underlying condition and treatment approach is important when considering the implications of the artificial heart in the treatment of heart disease. In the remainder of this chapter, we concern ourselves primarily with the use of the total artificial heart for patients with end-stage cardiac disease.

C. THE NEED FOR CARDIAC REPLACEMENT

The need for heart transplantation has been considered at great length in Chapters 10 through 14 of this report. Chapter 10, in particular, provided considerable information on previous attempts to

measure the need for cardiac replacement. Here I will summarize these estimates, consider how patient selection criteria affect need, and then produce a range of estimates for cardiac replacement based on relaxation of the age criterion for selection of recipients.

1. PREVIOUS NEED ESTIMATES

As noted in Chapter 10, several attempts have been made to estimate the need for cardiac replacement. In some instances these estimates have been for heart transplantation, in others, for the totally implantable artificial heart and, in still others, for various ventricular assist devices, both long- and short-term. These estimates, based on varying assumptions, have differed greatly from report to report, and none exhibit a level of sophistication in analysis that matches similar analyses undertaken by Manton and Liu (1984) for estimating chronic disease prevalence. Most estimates for cardiac replacement are based on what Manton and Liu (1984) refer to as a "static component model" and are deficient. Manton and Liu (1984:512) elaborate upon the deficiences of this approach as follows:

> ...for many chronic diseases it may be unsatisfactory to use currently manifest morbidity patterns to project future morbidity. Because the risk of acquiring many chronic diseases varies across birth cohorts, it is unlikely that the schedule of prevalence rates (stratified by demographic characteristics) for today's population will remain stable over a projection period. A second problem is that current morbidity estimates, derived from a variety of cross-sectional data bases (e.g., surveys and medical records) are limited to information on manifested stages of chronic diseases. Such data can only partially characterize the "natural history" of a chronic disease process and do not portray the effects, both current and future, of the lengthy preclinical phases of disease.

In their illness-death model, Manton and Liu (1984) are able to overcome many of these deficiencies by inferring morbidity and prevalence patterns from national mortality statistics.

In Chapter 10 we distinguished among several different types of need estimates. At the most general level we made a distinction between biological or true need and utilization-based need. In addition, we further distinguished among need, met need, and unmet need. These distinctions all apply to the analysis of the need for the artificial heart.

Rather than describe all the previous attempts to estimate the need for cardiac replacement, Table 43-2 has been prepared to summarize the various need estimates cited in Chapters 10 through 14. As shown, there is considerable variability in the estimates. Different methodologies have been used to produce these estimates. In addition, it is noteworthy that the estimates depict the prevailing prevalence of heart disease at the time each estimate was made. It is with regard to the latter point that an approach such as that of Manton and Liu (1984) is critical to the assessment of need. In actuality, due to the decreased prevalence of certain chronic heart diseases, perhaps the need for cardiac replacement will decline over the next several decades, as lifestyle changes have their impact upon heart disease prevalence.

2. PATIENT SELECTION CRITERIA

Patient selection criteria have the most marked affect on estimates of the need for cardiac replacement, and of these, perhaps age is the most significant. In short, need is a function of patient

Table 43-2
Estimates of the Need for Cardiac Replacement

PANEL, GROUP, OR PERSON	DATE OF REPORT	ESTIMATED NUMBER
Ad Hoc Task Force to NIH	1969	11,736 - 32,168
Artificial Heart Assessment Panel	1972	16,750 - 50,300
Schroeder	1979	75,000
Russell and Cosimi	1979	10,000 - 50,000
Advisory Council to NHLBI	1982	8,000 - 15,000
Lubeck and Bunker	1982	16,000 - 66,000
Pennock et al.	1982	1,000 - 5,000
Nose	1982	4,000 - 40,000
National Heart Transplantation Study	1984	1,200 - 14,100

selection. Liberal selection criteria will produce higher need estimates than will conservative selection criteria. It has generally been argued that patient selection criteria for the artificial heart may be less stringent than those for heart transplantation. In particular, at least up until the recent experience with Dr. Barney Clark, it was thought that comorbid conditions for which people would be excluded for heart transplantation would not preclude them from receiving an artificial heart. Also, it was felt that the age criterion could be relaxed somewhat. While age 55 is now considered the upper limit for heart transplantation, recent reports on the artificial heart suggest that age 65 may be an appropriate cutoff (Atsumi, 1984:916). However, the experience of the Utah group suggests that this may not be reasonable, at least in the short term (DeVries et al., 1984). DeVries and coworkers comment as follows on patient selection criteria:

> Selected patients from three groups appear to be suitable for the artificial heart: those who cannot be taken off cardiopulmonary bypass during surgery, those in whom irreversible cardiogenic shock develops (as from myocardial infarction), and those in whom irreversible end-stage heart failure develops progressively from ischemic disease, cardiomyopathy, and other causes of myocardial dysfunction.

Unfortunately, candidates for the artificial heart may have a variety of complications. DeVries and coworkers (1984:278) describe them as follows:

> Patients with end-stage chronic heart failure who are selected for the artificial heart are likely to have secondary prerenal azotemia, hepatic

> dysfunction, and pulmonary insufficiency. Facilitating the consent process may permit artificial-heart transplantation in patients with a more acute course (i.e., shock after acute myocardial infarction) whose other organ systems are intact and who may have a better prognosis. The chronic obstructive pulmonary disease in our patient did not require specific preoperative therapy, but it appeared to have an adverse effect on the postoperative course and may be avoided when future candidates are selected.

Without question, the experience with Dr. Clark has led the Utah group to modify their patient selection criteria. On June 18, 1984, the Food and Drug Administration (FDA) approved new patient selection criteria that will permit a device similar to that implanted in Dr. Clark to be implanted in a healthier patient. In approving the new procedures, the FDA has, for the second time, expanded the potential patient population that may be eligible for the artificial heart. The original protocol, approved in September, 1981, limited use of the Jarvik-7 heart to patients who were not candidates for a heart transplant and who could not be weaned from cardiopulmonary bypass. However, after a lengthy and unsuccessful search for the first candidate, the FDA agreed to permit implants in patients with cardiomyopathy. Patients had to be in the end-stage of disease and display severe symptoms even at bed rest for eight weeks before they could receive an artificial heart. Under the new protocol, end-stage cardiomyopathy patients will not be subjected to the eight-week waiting period.

Patient selection criteria for cardiac assist devices differ somewhat from those for the total artificial heart. The NHLBI Advisory Council (1982) concluded, for example, that "...results do

not justify the use of air-driven left ventricular assist pumps for permanent application in humans." Guidelines have been established, however, for employing the air-driven biventricular replacement device (BVRD). The Group noted that "...the air-driven BVRD would be appropriate in patients with cardiovascular conditions wherein survival for a year would not otherwise be possible with any other form of circulatory support." Examples cited in the report include patients who have (1) undergone heart surgery and have irreparable heart disease such as a non-repair acquired ventricular septal defect, (2) a large left ventricular infarction with rupture of the left ventricle, (3) certain forms of non-repairable congenital heart disease, (4) uncontrollable hemorrhage from ventricular rupture following mitral valve replacement, and (5) intractable ventricular fibrillation following an otherwise successful surgical procedure. The Working Group concluded that "Death on the operating table is certain if such a device is not employed and there is no alternative form of treatment for these patients."

Over time it is highly likely that the patient selection criteria for various cardiac replacement and assist devices will evolve further. This has certainly been the case with heart transplantation (Oyer et al., 1981), where improved patient outcomes and reduced costs have resulted in such refinements. Perhaps a major question will be to what extent the selection criteria for artificial heart recipients will differ from those for patients in need of heart transplants. In all likelihood the selection criteria will become increasingly similar. In some respects it appears that the patient

selection criteria for artificial heart recipients have become more liberal. However, when one examines the selection criteria that have been stated previously, the new criteria are not considerably more liberal than those for heart transplant recipients. In fact, when the criteria now used by the Utah group are compared with those that were used previously, it is clear that the altered criteria apply to initial subjects who will undergo implantation of the artificial heart experimentally. In other words, the criteria for experimental subjects were too stringent previously. The relaxed criteria are intended to improve patient outcomes and reduce operative and postoperative complications. At any rate, as discussed below, any alteration in patient selection criteria can affect need estimates profoundly.

3. REVISED ESTIMATES OF THE NEED FOR CARDIAC REPLACEMENT

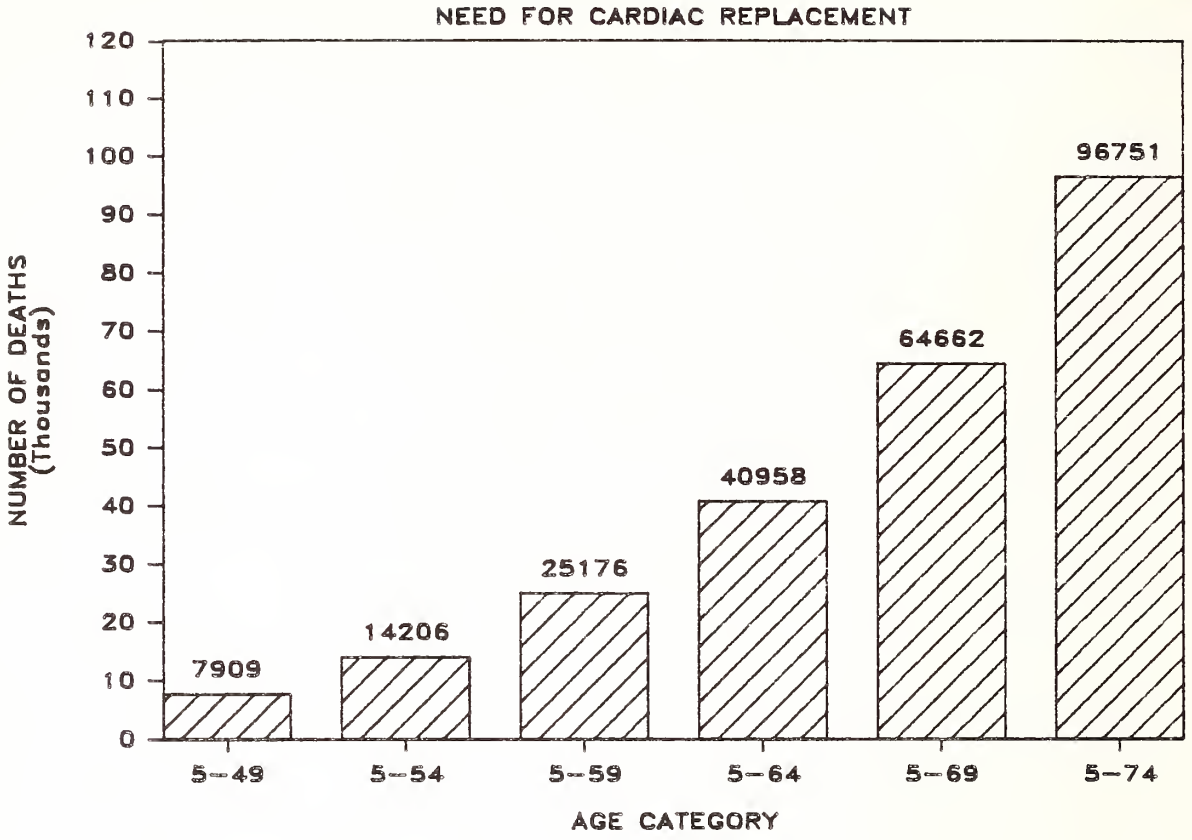
Based on results presented in Chapter 12 of this report, we have re-estimated the need for cardiac replacement. These estimates are based on all deaths in the U.S. in 1980, the most recent year for which mortality data were available at the time this report was written. As described in Chapter 12, cause-of-death statistics are based solely on the underlying cause of death. The underlying cause of death is defined as the disease or injury that initiates the train of events leading directly to death or as the circumstances of the accident or violence that produced the fatal injury (NCHS, 1984). When more than one cause or condition is entered by the physician, the underlying cause is determined by the sequence of conditions on the

death certificate, provisions of the International Classification of Diseases, and associated classification rules.

As described in Chapters 10 through 13, there are many contraindications to any form of cardiac replacement. Unfortunately, when using mortality data to estimate the need for cardiac replacement, it is impossible to take all these factors into account. Nonetheless, we have, once again, looked at mortality data for those conditions for which cardiac replacement may be indicated. The intent here is to show how need estimates are affected by age, when age is considered the sole contraindication to cardiac replacement.

As shown in Figure 43-1, need estimates by age category vary tremendously. In 1980, 7,909 persons between the ages of 5 and 49 years died with conditions for which cardiac replacement may have been indicated. Between the ages of 5 and 59, the number increases to 25,176 and between ages 5 and 74, 96,751 people died. It is doubtful whether all these <u>potential</u> candidates for cardiac replacement would have met all the stringent selection criteria for heart transplantation or the artificial heart, however. While the number of <u>actual</u> candidates may be quite small, it is nonetheless evident that the pool from which these candidates are drawn increases as the age at which people are considered eligible for cardiac replacement increases. It is noteworthy that if persons of all ages were considered eligible for cardiac replacement, the total number of deaths in the U.S. in 1980, due to selected conditions for which cardiac replacement may be indicated, was 272,593.

FIGURE 43-1


NEED FOR CARDIAC REPLACEMENT
NUMBER OF DEATHS (Thousands)
120
110
100
90
80
70
60
50
40
30
20
10
0
7909
14206
25176
40958
64662
96751
5-49
5-54
5-59
5-64
5-69
5-74
AGE CATEGORY

In conclusion, these new estimates of the need for cardiac replacement should be a source of concern as policies are developed concerning all forms of cardiac replacement. While, in principle, it is unlikely that there will be a shortage of viable artificial hearts, once one has been developed, the demand for them could easily outstrip the supply of cardiac surgeons and related medical specialists to perform the required procedures. This issue will be discussed further in the next section.

D. THE AVAILABILITY OF THE ARTIFICIAL HEART

Unlike heart transplantation, the availability of the artificial heart is unconstrained by the availability of donor organs. A mechanical form of cardiac replacement is limited only by production capabilities. At least initially, the production of such a device may be hampered, thus creating the impression that supply is inadequate to meet the demand. Like most innovations, it is almost always the case that initial demand exceeds supply. A balance between need and supply, however, is often achieved within a short period of time.

As alluded to above, perhaps a more serious concern is the supply of personnel and facilities required to perform artificial heart implantations. Lubeck and Bunker (1982b) have examined this issue in some detail. Based on interviews they conducted with leaders in the field, they were able to get some idea of what was required to start an artificial heart program. They concluded that the services of an open-heart surgery team, as currently configured, plus an associate surgeon and an artificial device engineer will be required for

artificial heart implantation. The estimated personnel requirements in the operating room are listed below:

SPECIALIST	HOURS
Chief surgeon	4-5
Associate surgeon	2-3
Anesthesiologists (2)	7-8
Heart-lung machine operators (2)	7-8
Residents (3)	7-8
Nurses (3)	7-8
Technicians (2)	7-8
Artificial device engineer	4-5

Lubeck and Bunker (1982b:13) conclude that these requirements are substantial considering the burden already placed on surgeons and nurses who are involved in various types of cardiovascular work. Moreover, they note that "artificial heart surgery, like heart transplantation, is likely to disrupt any hospital's schedule." They also acknowledge, correctly, that the surgery involved in artificial heart implantation is a small part of the total patient care process.

In general, over the past decade there has been a continued increase in the supply of cardiovascular surgeons. In 1976, there were 2,020 thoracic surgeons, of which, it was estimated 39 percent were active cardiovascular surgeons. The increase per year has been estimated to be about 15 percent (Preston, 1977). Using these figures, Lubeck and Bunker (1982b) estimate that in the coming decade

there will be between 800 and 1,000 surgeons available to perform artificial heart surgery.

In 1982, 648 hospitals in the U.S. had open-heart surgery facilities. In 1972, 432 hospitals had such facilities, and in 1976, 600 did so. Hypothesizing that 33,600 implants per year are performed, and 800 hospitals have open-heart surgery facilities, Lubeck and Bunker (1982b:13) conclude that each hospital would average 42 implants per year.

Unfortunately, at this time it must be concluded that not enough information is available to project all the resource requirements for an artificial heart program. More accurate estimates of need, more data on the availability of medical and surgical specialties, and more accurate projections of the number of open-heart surgery facilities are required before the availability of the artificial heart can be reasonably stated.

E. PATIENT OUTCOMES--SURVIVAL AND QUALITY OF LIFE

As described in Chapter 41, in the assessment of any health care technology that is potentially life-saving, two outcomes are of primary importance--survival and quality of life. Both of these outcomes have been discussed at great length in this report as they relate to heart transplant recipients.

At this point in time any analysis of the survival and quality of life of artificial heart recipients is necessarily premature and, therefore, hypothetical. Sufficient experience has yet to be gained with permanent implantable devices. Only three patients have received

totally implantable hearts. The longest survivor lived 112 days. The other two patients were recipients of an orthotopic mechanical heart as part of two-staged cardiac transplantation (Cooley, 1984). The first patient was supported by an artificial heart for a 64-hour period and died 32 hours after cardiac transplantation. The second patient was supported by an artificial heart for 54 hours before receiving a cardiac transplant.

Despite these scanty data, Lubeck and Bunker (1982b) have attempted to forecast artificial heart recipient survival under varying scenarios. Table 43-3 is a table that contains estimates of increased life expectancy associated with implantation of the artificial heart. As shown, under their "best case" assumptions, Lubeck and Bunker (1982b) project that a randomly chosen 25-year old gains 0.0966 of a year (or approximately 35 days) in life expectancy. Under their "worst case" assumptions, the gain is reduced to 0.0218 of a year (or about a week). On the average, they estimate that the artificial heart will extend the lives of individuals with cardiac disease by 0.6 of a year (about 210 days).

Quality of life is indeed an important consideration, not only to persons who receive an artificial heart, but to any person who is chronically or terminally ill. Increasingly there is concern about the quantity versus quality of life trade off. It is quite surprising what people are willing to endure to survive. However, based on the work of McNeil and coworkers (1981; 1982a; 1982b), it seems there is a threshold limit. For this reason, it is not surprising that the NHLBI Advisory Council (1982) has included consideration of quality of life

Table 43-3
Increase in Life Expectancy in Years For Randomly Selected Individuals of Specified Ages Who May or May Not Develop Ischemic Heart Disease--Best and Worst Case

BEST CASE		WORST CASE	
AGE	INCREASE IN LIFE EXPECTANCY	AGE	INCREASE IN LIFE EXPECTANCY
0-14	0.096	0-4	0.0214
5-14	0.0963	5-14	0.02146
15-24	0.0966	15-24	0.0215
25-34	0.0966	25-34	0.0218
35-44	0.0963	35-44	0.02096
45-54	0.0804	45-54	0.0151
55-64	0.0306	55-64	0.0011
65-74[a]	-0.0602	65-74[a]	-0.019
75-84[a]	-0.0137	75-84	0.0
85 or more	0.0	85 or more	0.0

[a]Negative values in persons over age 65 reflect the impact on this age group of patients who have received the artificial heart prior to age 65 and who bear the added risk of death due to complications or disease.

SOURCE: Lubeck and Bunker, 1982b.

in its deliberations. The Council has offered the following observation:

> No previous innovative therapy has had such implications for changes in life style or the quality of life. The analogy to long-term hemodialysis is not relevant because dependence on the external device is intermittant in contrast to the permanent tethering necessary with air-driven devices. Furthermore, dialysis is not accompanied by a signal of its importance 60-70 times per minute. Society should be assured that this advancement of knowledge and medical care does not demand an inordinate sacrifice from the recipient of the artificial heart and his/her family.

In reviewing the Utah experience with Dr. Barney Clark, Woolley (1984:293) alludes to the fact that even during the institutional review board process, the group was concerned about the quality of life issue. He notes, however, that the concept of quality of life is elusive, nebulous, and variously defined. The topic is, indeed, complex as described by Woolley:

> Reasonable quality may mean that the patient's level of function is consistent with that of a "typical" person of the same age. On the other hand, some would argue that for patients eligible for an artificial heart, life at any functional level above coma should be considered of adequate quality. The institutional review board adopted a moderate course by suggesting that in all likelihood, patients chosen to receive the artificial heart would already have had to endure a restricted life style because of preceding illnesses. This would be especially true of patients with end-stage congestive failure.

Of course, not all would agree with Woolley's assessment of the quality of life situation of recipients of the artificial heart. They may agree that the concept is elusive, but they might well argue that

there is some baseline quality of life, however defined, that people may be unwilling to compromise on.

As described in Chapters 23 through 26 of this report, there are numerous commonly used indicators of quality of life. They include employment status, ability to work, functional impairment, well-being, life satisfaction, and psychological affect. Not all assessments of quality of life are as comprehensive as the one we have undertaken here on heart transplantation. Most studies focus on return to work as the primary quality of life indicator. Obviously, as of this date, no artificial heart recipient has lived sufficiently long to be discharged from the hospital, let alone return to work. Nonetheless, in their assessment of the artificial heart, Lubeck and Bunker (1982b) have attempted to project the level of quality of life that artificial heart recipients are likely to achieve. In arriving at their estimates, they used several proxies, including heart transplant recipients, and patients who have undergone coronary artery bypass grafts. Return to work was the only quality of life indicator they considered. In doing so they estimated, based on the report by Reiss and coworkers (1982), that 20 to 25 percent of heart transplant recipients returned to work (our analysis shows that 31.6 percent of the patients are working). Interestingly, Lubeck and Bunker (1982b:29) argue that "Because cardiac transplantation leaves the recipient prone to infections and rejection from the body's immune system, however, we believe this percentage is lower than might be expected among recipients of an artificial heart." Although this may be true, being tethered to a power unit to drive an artificial heart

does not offer great prospects for a return to work by artificial heart recipients.

Lubeck and Bunker (1982a:29) then suggest that return-to-work figures for the coronary bypass group represent an "upper limit" to be attained by artificial heart recipients. They quote return to work figures of 70 to 80 percent for CABG patients under age 55 and from 50 to 70 percent for CABG patients between age 55 and 65.

Based on the return to work figures for cardiac transplant recipients and CABG patients, Lubeck and Bunker (1982b) conclude that between 20 and 60 percent of the persons receiving artificial hearts are likely to return to work.

In summary, it seems appropriate to reiterate a point made at the outset of this discussion of the survival and quality of life of artificial heart recipients. At this time, it is premature to arrive at any conclusions concerning the survival and quality of life of the recipients of the artificial heart. Enough experience has not been gained to make a reasonable assessment of either of these two patient outcomes. In the future, however, both will remain important considerations as more people receive artificial hearts as their primary treatment of end-stage cardiac disease.

F. COSTS ASSOCIATED WITH THE ARTIFICIAL HEART

In many respects, computing the cost of the implantation of the artificial heart underscores one of the major dilemmas I fear in the assessment of health care technology--the premature abandonment of development efforts via the premature calculation of cost. It is

undoubtedly too early to undertake a reasonable and comprehensive assessment of the cost of the artificial heart. DeVries and coworkers (1984) and Pierce and associates (1982; Pennock et al., 1983) have demonstrated the feasibility of a variety of approaches to cardiac replacement, and in light of these efforts, at least one observer has noted that cost should not be a primary consideration at this time. Galletti (1984:314) closes his recent editorial on the artificial heart as follows: "I expect that our outlook on heart replacement will gradually change as technology progresses. In the interval, fear of an imminent major impact on health care services and costs is not justified." Nonetheless, public health policymakers and legislators (Strauss, 1984) inevitably concern themselves with costs when an innovation appears to have very dramatic and startling implications, as does the artificial heart. Consequently, those involved with the development of the artificial heart, or other cardiac assist devices, are placed in the uncomfortable position of deriving estimates of cost regardless of their prematurity.

In deriving cost estimates, emphasis is placed not only on the medical costs of artificial heart implantation, but also on the social costs associated with its use. Nose (1982:378-379) typifies the argument in his assessment of people who could benefit from the artificial heart:

> If these patients were bedridden as cardiac cripples, they would be nonproductive and would require constant care by other individuals for possibly many years. With an implanted cardiac prothesis, the recipient can be an active and productive member of society.

Nose (1982:378-379) continues with a rather crude cost-effectiveness argument by stating that the artificial heart differs markedly from both hemodialysis and heart transplantation:

> This (the artificial heart) is different from hemodialysis. Once a patient undergoes hemodialysis, maintenance costs about $25,000 per year, with an additional cost of $15,000 per year for medical service. However, a large, recurring, annual expenditure does not exist with the cardiac prostheses. Maintenance would be much lower than heart transplantation.

Despite this favorable assessment of the artificial heart, it remains highly superficial, and the zeal of the developer, although justified, can hardly lend the necessary element of objectivity to the analysis.

At this point in time, however, it does seem reasonable to consider what is known about the cost of the artificial heart. In doing so, it makes sense to distinguish between research and development costs, the cost of implantation and patient management, and artificial heart program costs. More is certainly known about the costs of research and development than any other aspect of artificial heart costs. Also, the costs of implantation and patient management vary according to the type of device that is being used. A variety of cardiac assist devices are now frequently used on a short-term basis, while life sustaining devices, such as the total artificial heart (TAH) are used very infrequently.

1. THE ARTIFICIAL HEART: RESEARCH AND DEVELOPMENT COSTS

Strauss (1984), in his highly critical appraisal of the "political history of the artificial heart," estimates that $200 million has been spent by the government on artificial heart research

over the past two decades. While firms in the private sector have undoubtedly contributed research and development funds, the total share, up until recently, has been proportionately small. Since Kolff Medical (now Symbion, Inc.) has gone public, however, this situation is likely to change significantly. For example, on June 15, 1983 the availability of 1,500,000 shares of common stock in this Salt Lake City-based firm was announced (Prospectus, 1983). Strauss (1984) reports that besides Drs. Willem Kolff and Dr. Robert Jarvik, "major stockholders include such financial giants as American Hospital Supply, Humana, Johnson and Johnson, and the Hospital Corporation of America." It is now estimated that private firms have contributed over $5.0 million to Symbion, Inc. for the development of the artificial heart.

Recently the status of Symbion, Inc. and the continuation of artificial heart research at the University of Utah has become unclear. On July 30, 1984, Dr. William DeVries announced that he will be leaving the University of Utah to join the Humana Heart Institute in Louisville, Kentucky. Dr. DeVries is the only physician in the U.S. approved by the Food and Drug Administration to implant the artificial heart. In a statement issued on July 31, 1984, Symbion, Inc. President Robert Jarvik indicated that the company will continue to work closely with the University of Utah artifical heart research program, which will continue despite DeVries' departure. Jarvik noted that "We will do everything we can to support the establishment of a new principal investigator" there (The Blue Sheet, August 8, 1984, page P&R 3).

It is now expected that significant artificial heart implant activity will shift to the Humana Heart Institute, which plans to establish a heart replacement program to include both human transplants and artificial heart implantations. DeVries has evidently been assured that Humana will "underwrite at least 100 artificial heart patients, to absorb costs now picked up by third party payers and the patients themselves" (The Blue Sheet, August 8, 1984, page P&R 2). It is yet unclear exactly how these activities will be funded.

While the artificial heart program has had a rather stormy history--falling in and out of favor among politicians--research and development support for the program on behalf of the National Institutes of Health has stabilized at around $10 million per year, a rather modest investment of resources considering the allocation of resources to other research efforts.

Determining whether too many or too few resources are directed to any one public health program is a difficult proposition. On the one hand, the utilitarian principle of doing the most good for the largest number of people guides some resource allocation decisions, while, on the other hand, in some instances this very principle instills fear in policymakers. This is largely because of potential cost and rationing considerations. It is precisely in this latter respect that the artificial heart seems most threatening. Although diseases of the heart continue to lead all causes of death in the U.S. by nearly a 3 to 1 margin over malignant neoplasms (National Center for Health Statistics, 1984), people remain concerned about further support of research into the development of the artificial heart.

Other observers of the artificial heart have been more critical in their consideration of its costs and implications and suggest that we should reconsider our willingness to continue to support research into the development of the artificial heart. Although the argument is by no means new, Lubeck and Bunker (1982a:373) make the following observation:

> Current progress in the development of the artificial heart represents not only a great responsibility but an opportunity to carefully control the introduction of circulatory device technology. At this time, a clinically effective artificial heart is still many years away; investment in artificial heart devices may be no closer to saving lives than a comprehensive, preventative program. Therefore, decisions regarding expenditures on heart disease in our society should be considered carefully. The benefits and costs of the artificial heart should be compared to other social and medical programs designed to extend and improve the quality of life. The development of the artificial heart should be weighed against the required commitment of resources. If this commitment is assumed, the following issues must be considered: (1) who should receive the device; (2) who will absorb the costs of manufacturing and implantation; and (3) what opportunities will be lost through an inability to fund other social programs.

Rosenberg and coworkers (1982) at Pennsylvania State University express a very different view on the development of the artificial heart. Their argument is as follows:

> Although the development of a total artificial heart has been underway for over 20 years, no clinically satisfactory device exists today. It could be argued that given enough funds during this time period, the goal could have been accomplished. This might have been the case, but we are primarily

> interested in the technological problems involved in developing a total artificial heart under past and current funding levels.

Although the arguments pursued here are relatively straightforward, the solutions are by no means so.

Ultimately the question to be addressed concerns society's willingness to further allocate resources to the development of the artificial heart. Thus, as noted by Lubeck and Bunker (1982b), there is both a first and second order decision to be made in the development of lifesaving technologies. Calabresi and Bobbitt (1978) were among the first to suggest this. They argue that the first order decision for the artificial heart is the decision about whether or not to proceed with its development. The second order decision concerns who will receive the device and who will pay. It is quite clear, as experience with the End-Stage Renal Disease Program has shown, that it is easier to stop or change direction at the first order decision level than at the second.

2. IMPLANTATION AND PATIENT MANAGEMENT COSTS

Not surprisingly, cost data on the implantation of the artificial heart or various cardiac assist devices are nearly nonexistent. More than anything else, this lack of data probably reflects the stage in the development of these devices, for as DeVries and coworkers (1984:278) note, artificial-heart transplantation remains "highly experimental." It is difficult to do reasonable analyses of the cost of experimental procedures and it is no less difficult to project the cost of an experimental procedure that just becomes therapeutic. This point was underscored by the NHLBI Advisory

Council (1982) when it recommended that "...economic issues such as cost-benefit relations not be of primary concern unless and until these devices move closer to becoming accepted clinical therapy." Nonetheless, some attempts have been made to project the cost of the artificial heart as well as various ventricular assist devices (both left ventricular and right ventricular assist). These estimates, as uncertain as they are, are reviewed below.

Nose (1982:378), based on the experiences of the Cleveland Clinic, has offered some estimates as to the costs of the artificial heart. He estimates that the cost of the hardware alone (the heart) would be on the order of $20,000, although he suggests that mass production of any device would result in reduced costs. Nose (1982) projects the cost of surgery to be between $15,000 and $20,000. This yields a total estimated cost per patient of $35,000 to $40,000.

The NHLBI Advisory Council (1982:339-340) has provided cost estimates for ventricular assist devices. The Group estimates that the permanent left ventricular assist devices or the artificial heart can be manufactured at a wholesale cost of $15,000 to $20,000, and that surgical and hospitalization costs would be in the range of $18,000 to $22,000. The Working Group further notes, however, that "Such costs, particularly if multiyear benefits are achieved, are not outside the range of a number of accepted and widely practiced therapies."

Lubeck and Bunker (1982b) have clearly produced the most detailed analysis of the cost of the artificial heart and cardiac assist devices. They note that estimates of the cost of the

artificial heart vary, depending upon the energy supply. With regard to device costs, they state that an electromechanical left ventricular assist device (LVAD), at a production level of 5,000, would cost an estimated $10,000. They estimate that a 5-year device may cost $13,000 or $14,000, and that, in addition, batteries for such a device would cost several hundred dollars per year. Relying on cost estimates provided by Kolff, at the University of Utah, they estimate that the first air-driven totally implantable hearts will cost around $14,000.

Unlike Nose (1982), Lubeck and Bunker argue that "There is little potential for declining costs with mass production of the devices because of the high level of reliability demanded for the devices and the expensive marketing structure."

Table 43-4 is a reproduction of the cost of the artificial heart derived by Lubeck and Bunker (1982b:11). This table contains three estimates of the major items of expense incurred in the diagnosis, implantation, and recovery of patients.

Their lower bound cost estimates (A in Table 43-4) are based on a coronary artery bypass graft (CABG) proxy, a low estimate for the device of $10,000, and a low estimate for continuing care of $1,500 based on the experience with cardiac pacemakers. In short, Lubeck and Bunker did not expect "...the technological and continuing surveillance needs of artificial heart recipients to be less than emergency medical treatment and monitoring costs of cardiac pacemakers." In addition to recurring medical costs, battery costs have been included.

Table 43-4
Three Estimates of Major Items of Expense Associated With
Artificial Heart Implantation and Use

ITEM OF EXPENSE	A CABG PROXY	B CALCULATED FEES	C CARDIAC TRANSPLANT PROXY
Hospital care	$10,103	$10,822	$31,000
Professional fees	3,826	5,300	30,000
Device costs	10,000	12,000	14,000
TOTAL	$23,929	$28,122	$75,000
CONTINUING COSTS			
Medical care	$1,500	$2,000	$8,800
Batteries	300	300	---
TOTAL YEARLY	$1,800	$2,300	$8,800

Source: Lubeck and Bunker, 1982b:11.

The second cost estimate shown in Table 43-4 is based on calculations using prevailing hospital costs, professional fees, and a middle estimate of $12,000 for the device. Through extensive interviews with leaders in the field of artificial heart research, Lubeck and Bunker were able to arrive at estimates of the number of days patients would be hospitalized. In addition, they were able to arrive at estimates of professional fees.

Finally, the third cost estimate was based on cardiac transplant data to which Lubeck and Bunker had gained access (presumably at Stanford). In this estimate both hospital costs and professional fees are higher than for the other two estimates. Also, the device included in this estimate was an air-driven heart, estimated to cost $14,000, and not requiring batteries.

Lubeck and Bunker note that none of their estimates include costs that might be associated with surgical complications such as thrombosis, hemorrhage, and circulatory insufficiency. In other words, they have assumed a postoperative course that is uneventful. They conclude by stating that "...the hospital and implantation costs to the recipient of an artificial heart may approach the present fees associated with cardiac transplants and will certainly be higher than the present costs of CABG surgery."

The experience with Dr. Barney Clark in December, 1982 has resulted in revised estimates of the cost of the totally implantable artificial heart. While most of Dr. Clark's expenses incurred over a period of 112 days were covered through research grants, it is estimated that Medicare was billed for in excess of $100,000 for the

implant. This has prompted Preston (1984) to conclude that the cost of implanting the artificial heart is on the order of $100,000 to $200,000.

To summarize, there have been numerous attempts to derive estimates of the cost of implanting the artificial heart. All these estimates must be considered crude at this point in time. Only further experience with a variety of devices will yield more precise cost estimates. We now turn our attention to the program costs associated with the artificial heart.

3. PROGRAM COSTS ASSOCIATED WITH THE ARTIFICIAL HEART

Simply totaling the charges associated with each implant of the artificial heart does not provide an accurate assessment of the program costs associated with this device. In addition, as noted by Lubeck and Bunker (1982a):

> Federal funding for artificial heart implantation involves additional costs and planning for adequate facilities, trained personnel, and a strong program to rehabilitate patients who must deal with the inconvenience and anxiety related to daily recharging of batteries, potential mechanical or electrical failure, and total reliance on an implanted machine. Cost considerations must take into account potential loss of other worthwhile programs displaced by the development of the artificial heart. The artificial heart may proportionately raise social expenditures financed through Medicare and Social Security from other social programs. Funds that support the training of heart surgeons and technicians for a large-scale implantation program may deter research on cardiac disease prevention or alternative treatments.

These added "program costs" are obviously difficult to estimate and are frequently ignored. It is assumed, for example, that artificial heart implants will be performed at institutions that currently have

facilities for open-heart surgery. However, as described above, the demand for artificial heart implants could easily exceed the capacity of these institutions to perform the procedures. Moreover, the supply of cardiac surgeons may be insufficient to meet demands. Projecting into the future, Lubeck and Bunker (1982b) note that: "Under the assumption no new facilities would be required for artificial heart implantation, if one postulates a total of 33,600 implants a year and 800 hospitals have cardiac facilities, each hospital would perform an average of 42 implants per year."

Using their data, Lubeck and Bunker (1982b:12) have estimated the total costs associated with artificial heart implantation as shown in Table 43-5. Depending upon the number of procedures performed and the cost associated with each procedure, they project total costs of between $384 million and $4.95 billion per year.

The foregoing cost figures differ remarkably from those offered by the NHLBI Advisory Council (1982:340), but again the discrepancies are primarily due to differences in assumptions about the need for the procedure and the costs associated with it. The NHLBI Advisory Council (1982) arrived at the following conclusion with regard to cost:

> Total cost for implanting the device and follow-up care for the first year in 10,000 patients annually, a reasonable estimate for the first decade of the operational phase of the program would be six hundred million dollars per year.

In stating this conclusion, the Council, once again, parallels the artificial heart program with the End-Stage Renal Disease Program and

Table 43-5
Total Costs Per Year For The Artificial Heart

	TOTAL COSTS PER YEAR (IN MILLIONS) WITH IMPLANTATION COSTS OF:		
REPLACEMENTS PER YEAR	$24,000	$28,000	$75,000
15,000	$384.00	$448.00	$1,200.00
33,600	806.40	940.80	2,520.00
47,000	1,128.00	1,316.00	3,525.00
66,000	1,584.00	1,848.00	4,950.00

Source: Lubeck and Bunker, 1982b:12.

concludes that the artificial heart program is "not outside the bounds of social acceptance."

Clealy, very little can be said definitively about the total program costs associated with the artificial heart. Speculation, in this case, is quite hazardous. Miscalculations can condemm a potentially successful program or be used to support a program that may yield trivial benefits. Again, it is simply too early to arrive at reasonable estimates of the program costs associated with the artificial heart.

G. ETHICAL AND LEGAL ISSUES ASSOCIATED WITH THE ARTIFICIAL HEART

Over the past fifteen years, numerous panels and commissions have addressed the ethical and legal implications of the artificial heart. Many of these panels and commissions have had a much broader charge including an examination of the medical, psychological, and economic implications of the artificial heart as well (Caplan, 1982). For example, in 1968 the National Heart Institute appointed an ad hoc task force of physicians and social scientists to review the moral, social and economic consequences of cardiac replacement (Ad Hoc Task Force on Cardiac Replacement, 1969). Another panel with similar objectives was formed in 1972 by the National Heart and Lung Institute. In its 1973 report, the Artificial Heart Assessment Panel (1973) provided a very broad review of numerous social dilemmas that were associated with the artificial heart. The key issues touched upon by the members of both panels included issues such as distributive justice, the right to treatment, and the "psychological burdens of life utterly dependent on

a mechanical device" (Caplan, 1982). Not surprisingly, these issues were also discussed at great length following the implantation of the artificial heart in Dr. Barney Clark.

Caplan (1982), in his review of the activities of the various artificial heart panels has concluded that "the ethics of allocation appeared to be the most troubling issue." He also concluded that "earlier technology assessments look, in retrospect, premature and overly optimistic." Caplan (1982) now feels, in light of recent implant attempts, that the moral issues raised by artificial hearts have far more to do "with the regulation of research involving human subjects than with moral quandaries about the allocation of scarce medical therapies." He cites, for example, Dr. Denton Cooley's July 23, 1981 implant into Willebrordus Meuffels as in violation of Food and Drug Administration regulations concerning new medical devices. However, there was ambiguity concerning this case because the heart implanted in Meuffels was not intended to be the sole means of extending the patient's life. Instead, the device was used as part of a two-staged operation that included a heart transplant.

The artificial heart has also raised questions about the experiment-therapy dilemma. It has been argued, for example, that the device Cooley implanted into Meuffels was a custom-made device designed for a particular purpose. Such devices are considered highly investigational and are not intended for wide-scale use. This issue, as described in Chapter 42, is very difficult to resolve.

Although not discussed at great length today, a nuclear-powered heart raises some interesting questions. Such a device clearly has

advantages over pneumatic systems. For example, the patient is not tethered to an external power source, nor is there the associated noise and lack of mobility. But, there is a problem of radiation exposure (Ad Hoc Task Force on Cardiac Replacement, 1969). Lubeck and Bunker (1982b) have estimated that radiation exposure via the artificial heart could result in 3,000 to 15,000 cancer deaths annually (depending upon the assumptions made in the calculation).

The legal issues associated with the artificial heart are, to some extent, intertwined with the ethical issues, although some interesting legal issues are separable from those that are primarily ethical. Many of these legal issues are similar to those associated with heart transplantation. For example, unique legal questions concern the privacy of the recipients of artificial hearts; who is qualified to perform the implant procedures; the regionalization of facilities for implanting artificial hearts; and concerns about legal liability. Various legal issues relating to the patient and his or her entitlement to various benefits also include an element of ethical concern.

H. CONCLUSION

The artificial heart in its varied forms is a complex device. The types of devices that are available today are designed to treat a variety of heart conditions, not all of which are necessarily end-stage. Left ventricular assist devices have been designed for both long and short-term use, while the totally implantable heart is

intended for those patients who have end-stage cardiac disease that is not amenable to conventional medical and surgical management.

Estimates of the need for cardiac replacement are largely dependent upon the criteria used to select patients. We have demonstrated that need estimates vary considerably on the basis of age alone. We estimate, for example, that regardless of age, as many as 272,593 could benefit from cardiac replacement each year in the U.S., although most of these people would not meet prevailing patient selection criteria. If age is considered a relative contraindication, we estimate that 14,206 people between the ages of 5 and 54 could benefit from some form of cardiac replacement each year.

In principle we argue that the artificial heart, if mass produced, could be made available to all patients in need. In other words, the artificial heart is not limited in the same sense that organ donors are for cardiac transplantation. The initial shortage, should a viable heart become available, is more likely to be in the facilities and staff available to perform the implant surgery.

In general, we conclude that it is too early to judge both survival and quality of life outcomes of artificial heart recipients. Simply too few procedures have been performed. This has not precluded others, however, from quantifying patient outcomes. For example, on average, Lubeck and Bunker (1982b) estimated that the artificial heart will extend the lives of individuals with cardiac disease about 210 days. They further estimate that between 20 and 60 percent of the artificial heart recipients would return to work.

The costs of artificial heart implantation are also difficult to estimate at this stage in the development of the device. Over $200 million has now been spent on the development of the artificial heart, however. It is estimated that the cost of the various cardiac devices will range between $12,000 and $16,000. Depending upon the number of implants performed per year, the program costs associated with the artificial heart are considerable--a low of $384 million to a high of $4.95 billion.

The ethical and legal issues associated with the artificial heart are very similar to those surrounding heart transplantation. These issues concern patients and providers, but perhaps none is as important as the resource allocation issue raised by the artificial heart. In this regard, the remarks of Dr. Peter Frommer, Deputy Director of the National Heart, Lung, and Blood Institute are most insightful (Frommer, 1981:1646):

> Expensive technologies are not new to the medical scene, but they must be assessed on the basis of their benefit as well as net cost. Cost-benefit decisions are intrinsically difficult and unpleasant when they deal with human life and with the quality of human life. Decisions on the use of expensive technologies are difficult because they may appear applicable to patients who would derive widely differing degrees of benefit. Hence, the cost and benefit will not be specific for a therapy but will vary in subgroups of patients from the clearly acceptable to what most would consider unacceptable.

With regard to the artificial heart, Frommer (1981:1646) comments as follows:

> Even if only a relatively small fraction of patients now dying with heart disease were to receive such a system,

> the impact on society, medicine, and the cost of medical care would be substantial.

Frommer (1981), in part, concludes that "Society must come to accept the fact that all the stops cannot be pulled out on every patient all the time, even in the difficult situations in which emotional or familial bonds are involved."

Cortesini (1984:878) has provided a broader perspective on the resource allocation issue. He comments as follows:

> In 15 or 30 years, the total cost of artificial organ implantation in any country may very well approach that of its military budget. Are not a nation's defense and the health and well-being of its members of similar importance? Perhaps the greatest responsibility of doctors around the world in the next 20 years will be to urge priorities for medical care, to oppose politicians with contrary views, and to insist that appropriations for medicine be at least equal to those for defense.

This issue, as well as other related issues, will be discussed in greater length in Chapter 45 of this report.

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CHAPTER 44

LESSONS LEARNED FROM THE END-STAGE RENAL DISEASE EXPERIENCE: THEIR IMPLICATIONS FOR HEART TRANSPLANTATION

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A. INTRODUCTION

The most comprehensive analysis of the End-Stage Renal Disease (ESRD) Program of Medicare was completed by Rettig in 1980 (Rettig, 1980a; 1980b). Rettig's report is a detailed account of the first six years of the ESRD Program wherein he examines the implementation of the program and studies the mechanisms by which policy control is exercised within the federal bureaucracy. The report illustrates very nicely the complex manoeuvering that occurs when legislators, policymakers, physicians, and patient-consumers attempt to avoid what Calabresi and Bobbitt (1978) have described as "tragic choices." It is in this regard that Rettig (1980a:1) when answering the question "Why study the ESRD program?" notes that: "This program claims our attention because life-saving medical treatment is being provided to a very small number of beneficiaries at a very high cost to society, the result of public policy to affirm the value that life is beyond price even though such affirmation requires substantial public resources."

Without question, heart transplantation raises many of the same questions that were just posed in connection with the ESRD program. Questions about who will pay, how much will be paid, who will receive a transplant, and how many, if any, will be performed are all questions that have, at one time or another, been asked of dialysis and kidney transplantation. For this reason it is instructive to consider the legislative history of the ESRD Program, examine its budgetary impact, address the problems of changes in the patient population and what they have meant, and speculate on possible changes that are in store for the program based on an analysis of

international policies. If one question was to capture the general intent of this chapter, it would be as follows: What lessons, if any, have been learned from the ESRD Program? The chapter concludes with a brief analysis of the implications that treatment of end-stage renal disease has for the treatment of end-stage cardiac disease.

B. THE ESRD LEGISLATION

By the mid-1960's dialysis and kidney transplantation had evolved to a point where both were considered to have therapeutic value. The problem, however, was that both transplantation and maintenance dialysis were beyond the economic means of most people. Two technologies were available to treat a chronic and eventually terminal disease, but people were simply unable to afford them. In response to this situation, Congress held several hearings in connection with legislation that included provision for payment for ESRD treatment services. Nonetheless, as noted by Rettig (1980a:27) "The policy authorizing the ESRD Program had lengthy antecedents...but a brief legislative history."

The bill containing the pertinent legislation was H.R.1 which initially contained very little specifically concerning dialysis and transplantation. H.R.1, introduced in the House of Representatives in early 1971 at the outset of the 92nd Congress, proposed a number of major amendments to the Social Security Act, "...including provisions for the consolidation of 54 federal-state programs for the needy aged, blind, and disabled; the establishment of more effective cost controls for Medicare and Medicaid; the provision of health care to Medicare

and Medicaid recipients through health maintenance organizations; and various modifications of the Social Security benefit structure" (Rettig 1980a:27-28). Also included were substantial modifications of the family welfare system. The latter proved to be the most controversial aspect of the bill and debates on welfare reform consumed so much time that passage of any bill appeared to be threatened. Nonetheless, given the upcoming election year, Congress was bent on getting legislation on the President's desk by election day, November 7, 1972 (Rettig, 1980a:28).

During the extensive hearings on H.R. 1, neither the House nor the Senate heard testimony on renal disease. In November, 1971 the House Ways and Means Committee, while hearing testimony on national health insurance, did gain exposure to end-stage renal disease as it was recommended that coverage for this be included as part of a national health insurance program. It was during these hearings that a patient was dialyzed in the hearing room before members of the Ways and Means Committee, and in December, Representative Wilbur Mills (D., Arkansas) introduced a bill to amend the Social Security Act and to provide financing for the treatment of patients with chronic renal failure.

The ESRD amendment was never considered by the Senate until the provisions of the entire bill were being debated. On September 30, 1972, Senator Vance Hartke (D., Indiana) proposed an amendment on chronic renal disease that was quickly adopted and the provision ultimately became "simply one part of an already complex bill," signed by President Nixon on October 30, 1972 (Rettig, 1980a:29).

As described by Rettig (1980a:30), the intent of Congress in passing the ESRD legislation was "relatively clear" -- "the amendment was to provide access to life-saving therapy for all who needed it where the costs of treatment was beyond the means of practically all individuals." Rettig (1980a:30) further notes that: "In providing access, the underlying rationale was to resolve the 'tragic choice' between this allocation of scarce resources and the value of human life." Cited in Rettig (1980a:30-31) are quotes from several senators which capture the overall temperament of the times. Senator Hartke said:

> In what must be the most tragic irony of the 20th century, people are dying because they cannot get access to proper medical care. We have learned how to treat or to cure some of the diseases which have plagued mankind for centuries, yet these treatments are not available to most Americans because of their cost...Mr. President, we can begin to set our national priorities straight by undertaking a national effort to bring kidney disease treatment within the reach of all those in need.

Senator Henry Jackson (D., Washington) said:

> I think it is a great tragedy, in a nation as affluent as ours, that we have to consciously make a decision all over America as to the people who live and the people who will die. We had a committee in Seattle, when the first series of kidney machines were put in operation, who had to pass judgment on who would live and who would die. I believe we can do better than that ... So I would hope that we would make an effort here, at least a beginning, to approve the amendment, so that we can do better than we have done heretofore.

Senator Chiles (D., Florida) repeated a similar point when he said:

> ...in this country with so much affluence, to think that there are people who will die this year merely because

> we do not have enough of these machines and do not have enough dollars, so that we do have to make the choice of who will live and who will die, when we already know we have a good treatment that can succeed and keep these people alive, while we are working out other improvements on transplants, finding cures, and everything else necessary. This should not happen in this country.

Only a lone voice in the Senate decried the amendment. Senator Wallace Bennett (R., Utah) argued that this amendment along with others represented "Christmas in September" and was "...an additional straw that will break the back of the social security system." He also opposed the fact that renal disease was being singled out for special treatment. Bennett argued that, "A more reasonable way to handle this amendment, would have been to delay action until it becomes part of a broader health insurance bill."

The inclusion of what was to become Section 299I of the bill caught the Bureau of Health Insurance (BHI) of the Social Security Administration by surprise. Eventually BHI officials were able to secure a statement from Senator Long that, in Rettig's (1980a:33) words, "...established the basis for significant Medicare policy departures in the reimbursement of ESRD treatment and proved critical on several later occasions in the implementation of the (ESRD) program." Long stated that:

> With respect to the coverage of kidney dialysis and transplantation, the Secretary would have the authority todefine reasonable charges in terms related to the reasonable costs of the treatment provided and comparable charges for physicians' time and skills, since obtaining customary and prevailing charges for new and complex procedures--many of which will be reimbursed in all instances by the program--would be quite difficult administratively.

Section 299I was unique in extending Medicare benefits to nearly all persons with a single condition for which there were two established therapies --hemodialysis and transplantation. Medicare entitlement was established for individuals under 65 years of age who were "fully or currently insured" or "entitled to monthly insurance benefits" under the Social Security Act, or who were the spouses of dependent children of insured individuals, if the individual was "medically determined to have chronic renal disease" and required hemodialysis or renal transplantation to live. Eligibility was to begin "with the third month after the month in which a course of renal dialysis is initiated" and would end with the twelfth month after a transplant or after dialysis treatment had been terminated. Individuals meeting these criteria, the statute declared, "shall be deemed to be disabled for purposes of coverage under parts A and B of Medicare subject to the deductible, premium, and copayment provisions of Title XVIII."

In an attempt to control the number and distribution of providers of ESRD services, the statute also included provisions which imposed constraints on potential providers of ESRD services in the form of minimum utilization rates. The statute enabled the Secretary of

Health, Education, and Welfare to exercise some discretion in order that it might "limit reimbursement under Medicare for kidney transplant and dialysis to kidney disease treatment centers which meet such requirements as he may by regulation prescribe." This delegation of authority to the Secretary also included a provision allowing for "a minimum utilization rate for covered procedures" and "a medical review board to screen the appropriateness of patients for the proposed treatment procedures" (Rettig, 1980a). This latter provision may have been an explicit statement of legislative concern for quality of care or alternatively it may have been an echo of the committee approach to decisions on selection for treatment.

To summarize, Rettig (1980a:34) notes that the goal structure for the ESRD program consisted of several objectives, namely:

- To provide access to ESRD medical services, both dialysis and transplantation, to all those individuals eligible to receive such services.
- To insure the high quality of delivered services.
- To contain total program costs.

Despite amendments to the statute authorizing the ESRD program, these overall objectives have remained unchanged (Iglehart, 1982), although the objective of containing costs has become the subject of increased attention since a large proportion of the Medicare, Part B budget is now devoted to ESRD patients who comprise a very small fraction of all beneficiaries. As a result there have been attempts to deal with the cost containment issue. For example, in 1978, P.L. 95-292 was enacted to provide incentives for: (1) the use of lower cost, medically

appropriate self-dialysis, particularly home dialysis, as an alternative to high-cost institutional outpatient dialysis, (2) elimination of program disincentives to use of transplantation, and (3) implementation of incentive reimbursement methods to assure more cost-effective delivery of services to patients dialyzing at institutions and at home. Because overall program expenditures continued to increase each year further amendments were introduced in the Omnibus Reconciliation Act of 1981 to limit program costs by reducing reimbursement rates generally and encouraging greater use of home dialysis by reimbursing at one level--the composite rate--for all dialysis, whether as an outpatient or at home.

C. THE COST OF THE END-STAGE RENAL DISEASE PROGRAM

In testimony before the Subcommittee on Health, Committee on Ways and Means of the United States House of Representatives, on February 9, 1984, Dr. Carolyne Davis, administrator of the Health Care Financing Administration (HCFA), made the following statement:

> Medicare costs for ESRD patients were about $2 billion in 1982. This was about four percent of total program expenditures and represents about 13 percent of Part B expenditures. These expenditures were for 70,000 beneficiaries, or one quarter of one percent of Medicare beneficiaries, and they have grown much faster than were originally projected when the law was passed.

Indeed, as Davis' testimony indicates, there has been a tremendous increase in total program (Medicare) expenditures as well as the total number of (Medicare) beneficiaries. Table 44-1 summarizes this growth while Table 44-2 reveals the increase in the number of dialysis and

Table 44-1
ESRD Program Costs By Selected Years

YEAR	TOTAL PROGRAM COSTS
1965	NK
1968	NK
1969	NK
1974	$242 Million
1976	$450 Million
1980	$1.1 Billion
1982	$1.8 Billion
1983	$2.1 Billion

NK = Not Known.

Table 44-2
Number of Patients on Dialysis or Receiving
Kidney Transplants By Year

YEAR	TOTAL NUMBER OF PATIENTS ON KIDNEY DIALYSIS AT YEAR END	TOTAL NUMBER OF KIDNEY TRANSPLANTS PERFORMED EACH YEAR
1951-62		75
1963		163
1964		239
1965	300	305
1966	NK[a]	338
1967	NK	448
1968	800	676
1969	1,000	838
1970	2,456	1,091 (1,460)[b]
1971	3,482	1,616 (2,909)
1972	10,000	1,993 (2,852)
1973	11,000	3,017
1974	18,875	3,190
1975	22,000	3,730
1976	30,131	3,504
1977	32,435	3,973
1978	36,463	3,949
1979	45,565	4,271
1980	53,364	4,697
1981	58,770	4,883
1982	65,233	5,358
1983	72,028	6,112

[a]NK = not known.

[b]Numbers in parentheses reflect discrepancies in the literature.

SOURCES: OTA, 1982; HCFA, 1978; 1979; 1980; 1981; in press.

transplant patients by year. In 1965 there were approximately 300 patients undergoing chronic hemodialysis in the U.S. By January, 1968, this number had increased to more than 800, and by early 1969 more than 1,000 patients were receiving treatment at approximately 250 dialysis centers. In January, 1974, shortly after the Medicare ESRD Program began, there were 10,300 dialysis patients, and by the end of 1974 this number had increased to 18,875. In June, 1976, data reported by the Department of Health, Education, and Welfare indicated that there were approximatly 24,500 dialysis patients (Evans et al., 1981), and by the end of that year, 30,100 patients were on maintenance dialysis. Today there are more than 70,000 patients on maintenance dialysis.

A similar increase occurred with respect to kidney transplantation, also shown in Table 44-2, and the largest increase in transplants immediately followed enactment of Section 299I. Since then the number of kidney transplants has continued to increase and during 1983 more than 6,000 kidney transplants were performed at 159 renal transplant centers. The current distribution of ESRD patients according to treatment modality is shown in Table 44-3.

Although the actual cost per patient per year for treatment of end-stage renal disease (when adjusted for the rate of inflation) has decreased, total program costs have increased tremendously (Lowrie and Hampers, 1981; 1982).

Table 44-3
Distribution of ESRD Patients by Modality, 1983

DIALYSIS	NUMBER	PERCENT
In-Center Hemodialysis	57,031	65.5
Home Hemodialysis	4,323	5.0
CAPD	8,532	9.8
Intermittent Peritoneal Dialysis	1,535	1.8
Dialysis Training	607	.7
SUBTOTAL	72,028	82.9
TRANSPLANTATION		
All Functioning Grafts*	15,000	17.1
TOTAL	87,028	100.0

*These figures are estimates (from Krakauer, 1983) derived from what is known about the survival of transplants and the number performed each year

Over the years the proportion of total Medicare funds allocated to the ESRD Program has continued to increase, largely as a function of the growth in the ESRD patient population (Rettig, 1980a; 1980b). In 1978, ESRD benefit payments constituted 1.3 percent of the Hospital Insurance Trust Fund (Part A), while ESRD benefit payments for Supplementary Medical Insurance Trust Fund (Part B) amounted to 8.9 percent. By 1982, 13.0 percent of total Part B expenditures were allocated to ESRD patients, 4.0 percent higher than initially projected.

Since the ESRD patient population is not expected to stabilize in the near future (Eggers et al., 1984), it is expected that total payment costs will continue to increase. The estimated ESRD patient population and annual benefit payments, projected to 1991, are shown in Table 44-4.

In an attempt to better understand the continued actual and projected increases in the cost of the ESRD Program, questions are being asked about the selection of patients for dialysis and transplantation. Over the past decade, the ESRD patient population as a whole, has become older and sicker, their rehabilitation potential is less, and the complexities associated with treating patients with multiple comorbidities may contribute to greater overall ESRD program expenditures.

D. CHANGES IN THE COMPOSITION OF THE ESRD PATIENT POPULATION: THE RELAXATION AND ELIMINATION OF PATIENT SELECTION CRITERIA.

In a paper published in 1981, Evans and coworkers (1981) examined the ESRD patient population at two points in time in order to

Table 44-4
Projected Medicare ESRD Patient Population, And
Annual ESRD Benefit Payments

YEAR ENDING SEPTEMBER 30	AVERAGE ANNUAL ENROLLMENT (THOUSANDS)	TOTAL BENEFIT PAYMENTS (MILLIONS)	INCOME GENERATED BY SECOND PAYOR REGULATIONS (MILLIONS)
1974	16.6	$184	
1975	25.3	327	
1976	33.2	481	
1977	40.3	654	
1978	46.7	835	
1979	53.9	1,037	
1980	62.0	1,268	
1981	68.2	1,532	
1982	72.8	1,814	
1983	76.8	2,056	
1984	80.5	2,153	$10
1985	83.7	2,337	25
1986	86.7	2,561	35
1987	89.4	2,782	45
1988	91.2	3,004	55
1989	92.2	3,220	55
1990	93.0	3,437	60
1991	93.6	3,671	65

SOURCE: Susan Kunkel, Health Care Financing Administration, May 5, 1984.

speculate on how the effect of changes in composition of the patient population would have important health policy implications. Their analysis began with a brief discussion of how patient selection played a key role in passage of the ESRD legislation, an analysis that is particularly relevant today. They noted that:

> Until 1973 there was substantial patient selection by physicians or committees, and although all ESRD patients had a terminal condition, some had better prospects for treatment than others. Patients, if not treated on a first-come, first-served basis, were selected for treatment based on a number of criteria. These included, for example, age, medical suitability, mental acuity, family environment, criminal record, economic status (income, net worth), employment record, availability of transportation, willingness to cooperate in the treatment regimen, likelihood of vocational rehabilitation, psychiatric evaluation, marital status, educational background, occupation, and future potential (Fox and Swazey, 1974).

Clearly social class considerations and social worth often were more important in treatment decisions than other more equitable and less controversial criteria. In order to eliminate any access barrier, Medicare benefits were extended to all ESRD patients.

Comparing the ESRD patient population four years prior to passage of the ESRD legislation and five years after its enactment, Evans and coworkers (1981) found major changes in its composition. Table 44-5 reproduced from their report, shows that prior to Medicare, only 25 percent of dialysis patients were female, but by 1978 this figure increased to 51 percent. In 1967, 91 percent of dialysis patients were white, compared with 64 percent in 1978; blacks increased from 7 to 35 percent of the population. In 1967, dialysis patients on the whole were well-educated and 25 percent had attained a college degree,

Table 44-5
Social And Demographic Characteristics Of The
Hemodialysis Patient Population, 1967 and 1978

CHARACTERISTIC	POPULATION 1967, %	1978, %
Sex		
Male	75.0	49.2
Female	25.0	50.8
Race		
White	91.0	63.7
Black	7.0	34.9
Other	2.0	1.4
Education		
Junior high school or less	10.0	28.7
Some high school	17.0	17.2
High school graduate	27.0	28.4
Some college	20.0	18.2
College graduate	12.0	5.7
Postgraduate school	13.0	1.8
Unknown	1.0	0.0
Age, yr		
25	8.0	3.4
25-34	24.0	10.0
35-44	32.0	14.6
45-54	27.0	25.8
55	7.0	45.7
Unknown	2.0	0.5
Marital status		
Single	16.0	13.0
Married	79.0	61.8
Separated		6.3
Divorced	5.0	7.4 25.2
Widowed		11.5
Employment Status		
Employed	41.7	18.4
Unemployed	38.3	17.7
Disabled		53.6
Student	13.2	Not coded 63.8
Retired		10.2
Other	0.0	0.1
Unknown	6.8	0.0

SOURCE: Evans et al., 1981.

while in 1978 only 7.5 percent had done so. The average age of patients also changed dramatically before and after Medicare; in 1967 only 7 percent of dialysis patients were aged 55 or over but by 1978, this had increased to 46 percent. In 1967, only 5.0 percent of dialysis patients were separated, divorced, or widowed, while by 1978, 25 percent were. Another very significant change was that in 1967, 64 percent of all dialysis patients were working but by 1978, only 13 percent were.

These changes were consistent with the intent of the ESRD legislation--equal access was created for patients in need of treatment for chronic renal failure. The problem, however, has been that these changes have tended to limit the utilization of the lower cost treatment modalities--home hemodialysis and kidney transplantation. Evans and coworkers (1981:490) made note of this:

> It is also evident, however, that the trend away from home dialysis as well as the higher cost of therapy are due in part to the changing composition of the hemodialysis patient population.

They also suggested that medical considerations as well as sociodemographic factors were creating both cost and utilization problems:

> There are also an increasing number of patients starting to receive dialysis who have diabetes mellitus or other serious medical problems (Manis and Freidman, 1979; Blagg, 1977). These factors, along with age, combine not only to produce patients who are unsatisfactory candidates for home dialysis, but patients who are high users of other medical care services. Such patients are chronically ill, often requiring frequent hospitalization and a disproportionate share of other medical resources.

Such patients are among those most likely to receive disability benefits. As noted by Evans and coworkers (1981:490-491):

> ...considering that these patients are among the least likely to be rehabilitated, the disability benefits they receive also add greatly to the total cost of their care. Thus, the cost of dialysis per se is but only one component of the total health care and social welfare dollar expended for patients in this category.

In 1980, Rettig (1980a:viii) estimated that "...fully one-third of the ESRD beneficiaries are eligible for Social Security monthly disability (income support) benefits." Based on 1976 data, Evans and coworkers (1981:490) estimated that 36 percent of dialysis patients had total household incomes below the poverty level, and 46 percent of patients had a household income lower than when they began dialysis. In a more recent analysis, based on results from the National Kidney Dialysis and Kidney Transplantation Study, Garrison and coworkers (1984) determined that nearly two-thirds of the ESRD population are receiving federal income support either through the Social Security Program or Supplementary Security Income (see Table 44-6). Results shown in Table 44-7 reveal that the incomes of ESRD patients are substantially below those of the general U.S. population. Even with federal income support, nearly one-third of ESRD patients are living in households with an income below the poverty line (see Table 44-8).

Based on the foregoing, with the absence of patient selection criteria, the overall status, both medical and social, of the ESRD patient population has declined. Nonetheless, it is inappropriate to rule the ESRD program as unsuccessful--success it seems is a relative notion. Rettig (1980a:viii) comments on this as follows:

Table 44-6
Percent of ESRD Patients Receiving Income Support
Through Federal Programs by Treatment Modality

TYPE OF SUPPORT	TREATMENT MODALITY			
	IN-CENTER HEMODIALYSIS	KIDNEY TRANSPLANT	HOME HEMODIALYSIS	CONTINUOUS PERITONEAL DIALYSIS
Social Security Benefits (Disability or Retirement) Only	59.1	41.0	50.6	64.6
Supplementary Security Income Only	8.6	3.8	6.7	2.5
Both SSB and SSI	8.9	.7	2.5	0.0
Total Percent Receiving Federal Support	76.6	45.5	59.8	67.1
Sample Size	325	132	273	79

SOURCE: Garrison et al., 1984.

Table 44-7
1981 Family Income of ESRD Patients by Modality:
Percentage Distribution and Comparison
with All U.S. Households[a]

INCOME RANGE	TREATMENT MODALITY				
	IN-CENTER HEMODIALYSIS	KIDNEY TRANSPLANT	HOME HEMODIALYSIS	CONTINUOUS PERITONEAL DIALYSIS	ALL U.S. HOUSEHOLDS[b]
$ 0- $ 2,499	5.8	4.8	3.2	1.4	2.9
$ 2,500 - $ 4,999	24.7	10.4	11.9	12.9	7.6
$ 5,000 - $ 7,499	22.9	7.2	10.7	8.6	7.8
$ 7,500 - $ 9,999	8.2	5.6	7.1	7.1	7.1
$10,000 - $14,999	9.3	14.4	17.5	18.6	14.4
$15,000 - $19,999	10.3	11.2	11.9	11.4	12.3
$20,000 - $24,999	5.5	10.4	7.1	10.0	11.4
$25,000 - $29,999	4.8	10.4	7.5	4.3	9.7
$30,000 - $39,999	4.5	11.2	9.9	12.9	13.1
$40,000 - $74,999	3.4	12.0	10.7	12.9	12.0
$75,000 +	.7	2.4	2.4	0.0	1.7
Percent Below Poverty Line	41.7	23.2	21.4	15.7	--
Total Respondents	292	125	252	70	--
Total Nonrespondents	55	19	35	11	--

[a]This aggregate income measure includes any 1981 labor earnings (before tax) of all household members plus annualized imputations of any benefits (i.e., Social Security, pension, etc.), they are currently receiving. Other income from assets (dividends, interest, etc.) is not included in the sample estimates, but is included in the U.S. household estimates.

[b]The number of U.S. households in 1981 was 83,527,000. This percentage distribution is from Table 3 in the U.S. Bureau of the Census (1983).

SOURCE: Garrison et al., 1984.

Table 44-8
Percentage of ESRD Patients Below the Poverty Line
Receiving Federal Income Support

TYPE OF SUPPORT	TREATMENT MODALITY			
	IN-CENTER HEMODIALYSIS	KIDNEY TRANSPLANT	HOME HEMODIALYSIS	CONTINUOUS PERITONEAL DIALYSIS
Percent Receiving SSB and/or SSI	88.1	81.0	86.1	100.0
For those receiving benefits, benefit amount as percent of poverty line	52.3	48.0	54.9	58.7
Number Below Poverty Line	99	21	36	8

SOURCE: Garrison et al., 1984.

> In many ways the ESRD program is a success. Congress established it to pay for the treatment of individuals with kidney failure so that no one lacked access to life-saving treatment for financial reasons. Patients are receiving treatment, bills are being paid, and access to care is no longer an issue. Although program and individual treatment costs are high, the cost experience includes some encouraging aspects, and there is no reason to believe that quality of care has declined, even though more elderly and sicker patients are now being treated than before.

According to Iglehart (1982:493), Congress views the ESRD program similarly. In his words:

> Politically, Congress views the ESRD program with some ambivalence. Generally speaking, the program is deemed a success because it pays for the treatment of patients with kidney failure who otherwise might have been denied such care.

Despite these indications of success, the future of the ESRD program may not necessarily be the same as its past, although the nature of any changes are by no means clear, nor are they being openly discussed at this time. As the future of the Medicare program has become increasingly uncertain, so have the prospects of the ESRD program.

E. THE FUTURE OF THE ESRD PROGRAM

It is difficult to speculate on the future of the ESRD program. Perhaps the best one can hope for is to identify the signposts for the future (Blagg and Scribner, 1980a; 1980b; Blagg, 1983; Relman and Rennie, 1979). While at this time no overt attempt is being made to invoke a structured set of patient criteria with uniform application, there are serious efforts being made to increase economic efficiency

and, thus, reduce the cost of the ESRD program. As alluded to above, twice in the ten-year history of the program Congress has enacted ESRD amendments to the Social Security Act (Iglehart, 1982).

The first set of ESRD amendments came in 1978. These were intended to accomplish five major objectives, according to a document published by the Senate Finance Committee (Committee on Finance, 1981; cited in Iglehart, 1982:493):

> ...to provide incentives for the use of lower cost, medically appropriate self-dialysis, particularly home dialysis, as an alternate to high-cost institutional dialysis; eliminate program disincentives to the use of transplantation; provide for the implementation of incentive reimbursement methods to assure more cost-effective delivery of services to patients dialyzing in institutions and at home; develop a long-range objective, on the basis of the continuing review and judgment of professional peer review organizations, with respect to the most effective use of resources for treating renal disease; and provide for studies of alternative ways to improve the program and for regular reporting to the Congress on the renal disease program.

As a result of the 1978 amendments, several optional incentives intended to increase the use of home dialysis and transplantation were introduced. These included early entitlement without the 2- to 3-month waiting period for patients entering self-care dialysis training, 100% of the cost of purchasing home dialysis equipment, and the establishment of target rate reimbursement for home dialysis. This latter provided for a home dialysis treatment to be reimbursed at 70% (later set at 75%) of the adjusted regional rate for outpatient dialysis. Despite these changes, outpatient dialysis remained relatively profitable and an easier form of care to deliver; and so, with the exception of the development of continuous ambulatory

peritoneal dialysis, there was little increase in the use of home dialysis as a result of these amendments. Even worse, from the cost-containment viewpoint, the number of outpatient dialysis facilities, chiefly hospital facilities, with exceptions to charge more than the standard rate continued to increase; and by 1982 about half of all hospital dialysis units had such exceptions.

The second set of ESRD amendments were approved by Congress as part of the Omnibus Budget Reconciliation Act of 1981 (Blagg et al., 1982a; 1982b). These amendments were intended to establish a dual-rate reimbursement system that differentiates between hospital-based and freestanding dialysis facilities, promote home dialysis and transplantation, and strive for other improvements in efficiency in the program. The new regulations were published in the Federal Register on February 12, 1982 as a Notice of Proposed Rulemaking. This resulted in a storm of responses from organizations, professionals and patients, related especially to the question of whether there should be a dual rate or one single rate for both hospital and freestanding units, and also the level of reimbursement set, as this was based on outdated audit data from three to five years before.

While the new regulations would continue to provide for exceptions, control of the process for granting exceptions would be much tighter. Also included in the package was a significant change in the method of physician reimbursement for care of ESRD patients. The overall goal remained the same--to reduce federal costs through the promotion of home dialysis. In a memorandum to then Secretary of DHHS Richard

Schweiker, Dr. Carolyne K. Davis, Administrator of HCFA, noted the intent of modifying the current method of paying physicians:

> In consideration of our goal to stimulate home dialysis, we do not believe it is sufficient to place our emphasis solely on facilities to generate the desirable shift to more home dialysis; it is likely to equal or greater incentige belongs with the physicians.

Despite the barrage of comments, the proposed resulations were published in final form on May 11, 1983. As a result, the National Association of Patients on Hemodialysis and Transplantation (NAPHT), the Renal Physicians Association (RPA), and a freestanding dialysis facility joined forces to sue the government to attempt to block implementation of the new regulations. As of June 1984 the judge ruled that HCFA had set the rates at a reasonable level, and the judge believed that HCFA would monitor quality of care and safety carefully. However, certain other changes related to physician reimbursement and coverage were decided in favor of NAPHT and the other organizations. Currently, the Justice Department is considering an appeal based on the question of whether the courts have jurisdiction over procedural issues related to the Part B Medicare program--a precedent of great significance to health care generally.

Meanwhile the intent of the government remains clear--to contain costs through creating greater efficiency in the ESRD program. However, there is a limit to the degree to which increased efficiency can be fostered, and more drastic solutions may be in the offing. Dr. Constantine Hampers (cited in Iglehart, 1982:295), commenting upon the 1981 amendments, speculated that:

> ...the implications of the proposal will be devastating to beneficiaries. Even now, people are speculating that this is an attempt by HHS to emulate the English health care system, under which few patients over the age of 55 are accepted for treatment (dialysis).

The suggestion that some version of the British system may be adopted in the U.S. for the treatment of patients with ESRD, as well as other types of patients, is not completely unrealistic. Although such a suggestion is not being entertained either in Congress or by officials of the Health Care Financing Administration at this time, the suggestion that such a major overhaul of the health care system may be necessary is worthy of further comment (Iglehart, 1983; 1984).

F. AN INTERNATIONAL PERSPECTIVE

Aaron and Schwartz (1984) recently completed an extensive analysis of the British National Health Service (also see Schwartz and Aaron, 1984). In order to gain a better understanding of the resource rationing process, something Schwartz and Aaron clearly feel is inevitable in the U. S. due to "...resistance to the decades-long rise in the cost of hospital care," a careful study was undertaken to establish how the British allocate scarce funds among various technological approaches and patients. They conducted many interviews with officials of the National Health Service and with physicians and other providers. The technologies of interest included CT scanning, cancer chemotherapy, bone marrow transplantation, long-term dialysis, treatment of hemophilia, intensive care, coronary artery surgery, hip replacement, total parenteral nutrition, diagnostic X-ray examination, and radiotherapy.

Generally, Aaron and Schwartz (1984) found that the British are quite capable of living within limits. Of the therapies studied, only three were provided at the same levels as in the U.S. Hemophiliacs were provided medical care in the quantity and of the quality required, megavoltage radiotherapy was readily available and bone-marrow transplantation was provided at approximately the same rate as in the U.S.

Other technologies were rationed. For example, the overall rate of treatment for ESRD in Britian is less than half that in the U.S.; kidneys are transplanted at an equivalent rate, but dialysis is provided at a rate that is only one-third that in the U.S. Other technologies were similarly rationed. When compared with the U.S., the British perform half as many X-rays per capita, provide only one-quarter the amount of total parenteral nutrition, have only one-sixth the CT scan capability, one-fifth to one-tenth the number of intensive care beds relative to population, an perform one-tenth as many coronary bypass grafts as the U.S. However, there is some question as to whether the U.S. may be overproviding in some of these areas of care.

How is this accomplished in Britain? Schwartz and Aaron (1984) found that physicians serve as the gatekeepers and over time have "...developed standards of care that incorporate economic reality into medical judgments." Rationalization is frequent, and selection of patients for dialysis provides an example of the ease with which physicians are able to reconcile a set of difficult circumstances. Schwartz and Aaron (1984:54) describe the process as follows:

> ...an internist confronted with a patient beyond the prevailing, if unofficial, age at which one's chances of receiving dialysis become slight is likely to tell the patient and family that nothing of medical benefit can be done and that he or she will simply make the patient as comfortable as possible. A nephrologist with a patient for whom dialysis would be technically or socially difficult to manage may well say that dialysis would be painful and burdensome. A resident alien from a poor country may be told that he or she should return home--where, as it happens, modern care is not likely to be unavailable.

There is some freedom within the system to alter the explicit pattern of care, but the physician recognizes that this may well impact upon the quality and quantity of care that he is able to offer other patients. Nonetheless, occasions inevitably arise when the physician must say no--refusing to provide the older patient dialysis is a prime example. In this case, Schwartz and Aaron (1984:55) note that, "Often in such a case the local internist either does not raise the possibility of dialysis or simply states that the treatment does not seem to be indicated." Unlike patients in the U.S., the British are much more compliant and are likely to follow their doctor's orders with little complaint.

Commenting further on the denial of dialysis services to certain patients, Schwartz and Aaron (1984) note that:

> The local physician's role as gatekeeper explains why dialysis centers rarely have to turn away patients. Older patients are not usually referred because the local physician is well aware that they could not be accomodated. The general practitioner or internist thus spares the nephrologist from having to say no, spares the patient and family a painful rejection, and avoids having to face the patient and relatives after rejection.

While most patients are likely to comply with their local physician's recommendations, there are occasions when patients and their family may choose to "work the system." Some patients request, and get, a second opinion; others may choose to present themselves at an emergency room for treatment. In the case of dialysis, a patient refused dialysis may report directly to a clinic and, as one British nephrologist explained to Schwartz and Aaron (1984:56), "...a patient who sits down in the waiting room will probably be seen and a slot found for him or her in the dialysis program."

In other instances, patients may go from one geographic area to another to gain access to the care they want as budgets and priorities are established at the regional level. Such exploitation of geography, as Schwartz and Aaron refer to it, is relatively rare, but as Brahams (1984:386) so bluntly notes:

> The patient or his or her family may be able to persuade another health region to help or they may be able to afford the private sector, but for many the refusal to treat is the end of the road to the cemetery.

While the British system has effectively controlled health care costs and the growth of selected technologies such as kidney dialysis, transferability of the British approach to the U.S. is questionable (Laing, 1980). Schwartz and Aaron (1984) are cautious in this regard.

> Although there are differences between our two countries, one shared lauguage and the common elements in our political and medical cultures make the British experience relevant to the United States. To be sure, the British experience cannot be taken as a literal forecast for the coming years in the United States. For example, it seems unlikely that Americans would accept

> rationing as willingly as have the British, who have a special affection for the National Health Service since its creation just after World War II. Nevertheless, the British experiment has yielded the best data we are likely to find on an intensive program to curb medical expenditures.

At the conclusion of their analysis Schwartz and Aaron (1984:56) underscore the unique ability of the British to live within limits and offer cautious optimism:

> It appears doubtful that the citizens of the United States would accept such limits--or even less severe ones--as readily. If limits are set, however, we believe that they will stimulate responses in physicians and patients that will be similar in many respects to those we observed in Britain.

Even in Britain, disaffection with the selection of patients for renal dialysis is increasing (Wing, 1983; Iglehart, 1984). There have been several recent papers in the British Medical Journal which reflect this trend, including a report on the successful treatment of kidney patients over 65 years of age, and a paper arguing why blind diabetics should be offered dialysis. Iglehart (1984) notes that even popular television has been attracted to the issue, but then concludes:

> Thus far, though, there is no general evidence of change in the restricted availability of dialysis treatment in Britain. The officials at the Department of Health and Social Security with whom I discussed this issue said that any appreciable increase for renal dialysis simply is not a priority at this time.

In the end, the winds of change may prevail, however. Diana Brahams, a British barrister, has examined the "doctor's duty and the patient's right" in the treatment of end-stage renal failure. The

British Kidney Patient Association (BKPA) estimates that between 2,000 and 3,000 deaths occur each year in Britain from renal failure, many of which, are unnecessary. The BKPA has decided to escalate their efforts to attain more dialysis services for those in need and recently announced that the next patient refused treatment by the National Health Service (NHS) and who is brought to their attention will be treated privately at the Association's expense. Bills for the patient's treatment subsequently will be presented to the NHS and if they are not paid, in Brahams (1984:386) words, the BKPA "...is prepared, apparently, to take the Secretary of State to court--presumably for failing to provide necessary treatment as required under the National Health Service Act, the private hospital bills amounting in effect to damages."

In her analysis, Brahams notes that refusal to treat a patient can occur because: (1) the patient is too old and sick to be treated, or (2) there is a lack of facilities at which patients can be treated. To argue that a patient is untreatable because of a lack of facilities is clearly questionable:

> It seems to me that a doctor who tells a patient that he is untreatable when he is indeed treatable, but is simply not going to be treated because of the lack of facilities, is failing in his duty of care. Surely he should tell the patient that there would be a chance for him if he could receive the correct treatment and that he should seek it in a different health area which may have greater facilities.

She then goes on to concede that:

> After all, dialysis is nothing experimental and new: it is not an extraordinary way of keeping people alive only in one or two centres of the world; it is a treatment offered all over the UK and the industrialized world. On the other hand, the doctor may argue that if the patient is unlikely to find alternative treatment in a different region, then what is the point of upsetting both him and his family? Might it not be kinder and simpler to tell them that the condition is incurable and must be accepted? Yet, in so doing, the doctor is misinforming the patient and depriving him of the chance at least of receiving alternative care and any other legal options as yet untried that may be open.

Brahams (1984) makes it clear that in the future it may become increasingly difficult to deny ESRD patients dialysis or transplantation regardless of their social and medical characteristics. Perhaps the decision will ultimately rest with the courts. Her concluding remark is as follows: "As pleas for change by press and doctors and patients fail to elicit any positive response, the only alternative route seems to lie through either the criminal or the civil arm of the law--though such a course is dogged by expensive uncertainty."

Those close to the ESRD program in the U.S. have become fearful that a variation of the British system of rationing by simple exclusion ultimately may be adopted, perhaps on the basis of age and comorbidity. Thus, while there has been support for initiatives to reduce total program expenditures, there is also an implicit fear that there is a limit to such reductions without improving quality of care and/or access to treatment. Also, it is recognized that while technological developments may effectively reduce future program expenditures, no promising developments appear on the horizon at this time.

The U.S. stands out in stark contrast to many other countries with regard to treatment of ESRD patients. As shown in Table 44-9, the dialysis rate per million population in the U.S. greatly exceeds those of all countries represented in the European Dialysis and Transplant Association (Prottas et al., 1983; Eggers et al., 1983). Studies of cross-national policies for the treatment of ESRD patients have been completed recently by Evans, Blagg and coworkers (1984) and by Prottas and associates (1983), and both analyses illustrate how unusual the U.S. is in this regard.

Evans, Blagg and coworkers (1984) surveyed policies with regard to the treatment of ESRD in 30 countries. Twenty-two of the countries had a formal patient selection process, but in the majority the final decision was a medical one. Of the 22 countries with a formal patient selection process, in only 7 were all patients with ESRD treated, but, as in Britain, lack of formal referral of such patients to a major treatment center may act as a form of selection. In the other 15 countries some form of patient selection occurred.

Table 44-10 indicates the selection criteria used. As expected, patients are most frequently excluded from treatment on the basis of multisystem disorders and age. Social factors also play a significant role in the selection process, with psychological stability and availability of social supports being key factors, together with an estimate of the individual's "social worth" as evidenced by their social responsibility and contributions to the community. Ability to pay is a criterion of lesser importance, as are the various factors which would facilitate kidney transplantation as a treatment option.

Table 44-9
Dialysis Prevalence Rates

NATION	DIALYSIS PREVALENCE (Per Million)
Austria	69
Belgium	123
Denmark	86
Finland	36
France	133
West Germany	117
Greece	61
Ireland	47
Israel	144
Italy	120
Luxembourg	80
Netherlands	92
Norway	31
Spain	78
Sweden	65
Switzerland	127
United Kingdom	53
United States	209

SOURCE: Prottas et al., 1983.

Table 44-10
Patient Selection Criteria Followed in Countries With Formal Policies Regarding Treatment of End-Stage Renal Disease
(N = 15)

CRITERION	PERCENT MENTIONED	PERCENT NOT MENTIONED
Multisystem Disorders	80.0 (12)*	20.0 (3)
Age	60.0 (9)	40.0 (6)
Psychological Stability	33.3 (5)	66.7 (10)
Social Supports	20.0 (3)	80.0 (12)
Social Responsibility, Contribution	13.3 (2)	86.7 (13)
Ability to Pay	6.7 (1)	93.3 (14)
Suitability for Transplant	6.7 (1)	93.3 (14)
Eligible Living Donor Available	6.7 (1)	93.3 (14)
Other	26.7 (4)	73.3 (11)

*Number of countries is in parentheses.

SOURCE: Evans et al., 1984.

Other criteria, such as a poor prognosis and likelihood of early death, ability to comply with the treatment regimen, residential status, marital status, and occupation, also may be considered in the decision process.

Evans, Blagg, and coworkers (1984) also documented both primary and secondary sources of payment for ESRD treatment-related expenses. As shown in Table 44-11, the government most frequently (26 out of 30 countries) serves as primary source of payment for such expenses, and in the remainder of the countries studied the government was listed as a secondary source of payment. Private insurance and patients themselves are the most important secondary sources of support. Only one country each indicated that the patient or "other organizations" was the primary source of payment. Secondary sources of payment include, in rank order, private insurance and the patient, other organizations, the government, and public fund-raising efforts.

Ultimately, it is unclear what changes, if any, are likely to be made in the delivery of end-stage renal disease services in the United States. The U.S. is atypical when compared with other countries, but this is probably the result of several factors such as affluence that are not necessarily characteristic of many other countries. In this regard there is a clear relationship between the prevalence rate for ESRD treatment and gross national product (Jacobs et al., 1981). However, while other approaches to the ESRD problem have been applied successfully, in those countries where patient selection is common, there remains considerable uneasiness as characterized by the recent events in Britain. Further speculation on changes in the U.S. are

Table 44-11
Sources of Payment for Treatment Expenses
In All Countries
(N = 30)

SOURCE OF PAYMENT	TYPE OF SOURCE: PERCENTAGE PRIMARY SOURCE	TYPE OF SOURCE: PERCENTAGE SECONDARY SOURCE
Government	86.7 (26)*	14.8 (4)
Private Insurance	6.7 (2)	29.6 (8)
Other Organizations	3.3 (1)	14.8 (4)
Private Fund Raising	0.0 (0)	14.8 (4)
Patient	3.3 (1)	26.0 (7)

*Number of countries is in parentheses.

SOURCE: Evans et al., 1984.

beyond the scope of this report, but are likely to become increasingly focused in years to come. The general problem of resource scarcity, whether economic or otherwise, is, unfortunately, an issue legislators and policymakers will have to grapple with continually (Evans 1983a; 1983b).

G. CONCLUSION: IMPLICATIONS FOR HEART TRANSPLANTATION

Some important lessons with application to heart transplantation may be learned from the ESRD experience, but there are limits in the scope of application. For example, patients with ESRD have several treatment approaches or modalities available to them; transplantation and several types of dialysis are now used with varying degrees of success. Not all patients are equally well-suited to the available modalities, thus, raising the question of what form of treatment is best suited to which subset of patients. Also, dialysis is a mechanical approach to treatment, and transplantation a biological approach. While patients with cardiac disease have several modalities of treatment available to them, only one of these is directly applicable to end-stage cardiac disease (ESCD)--transplantation. Percutaneous transluminal coronary angioplasty (PTCA) is now widely used for patients in the early stages of heart disease (Dotter et al., 1983; Council on Scientific Affairs, 1984) and coronary artery bypass grafting is available to those whose disease has progresssed further. In addition, a wide array of drugs are now available for various heart problems, the benefits of which may not be reaped for several years (Braunwald and Colucci, 1984).

Treating end-stage cardiac disease is not directly analogous to treating end-stage renal disease for one major reason. The mechanical options available to ESCD patients are very limited, and no long term clinically effective device is currently available to substitute for the heart. Pierce and coworkers and others (Pierce, 1983; Pennock et al., 1982; 1983; Norman, 1981; NHLBI, 1982; Pierce et al., 1982; Sturm, 1982) have reported on progress with a variety of left ventricular assist devices, and DeVries and coworkers (Jarvik, 1981; DeVries et al., 1984) continue to make progress in the development of a totally implantable heart. Neither device, however, is likely to be available soon, although Pierce (cited in Simmons, 1984:700) predicts that clinical trials with an implantable assist device are expected to begin in 1988. He predicts that use of the device is "going to start off slowly," with at most 50 patients per year being involved.

Given the lack of availability of a long-term assist device or an implantable heart, speculation on the implications that the ESRD experience has for heart transplantation must be qualified appropriately. Nevertheless, relevant areas of concern include: (1) patient selection, (2) patient outcomes, and (3) treatment costs. Of these, patient selection is the primary consideration because both outcomes and costs will be profoundly affected by who is transplanted.

The legislative history of the ESRD program has revealed that it is very difficult to deny available lifesaving treatment to patients in need--despite relative medical and social contraindications. Thus, while a well-intended set of selection criteria can be derived, it is doubtful whether such criteria would remain unchanged with time. Poor

candidates for a heart transplant today, may be among the prime candidates tomorrow. Also, as described in Chapters 32 and 36 of this report, patient selection criteria may be suspended due to legal and ethical considerations. Consequently, any attempt to estimate need must take into account the great potential for relaxation of patient selection criteria.

A second lesson learned from the ESRD experience concerns patient outcomes, not only survival, but quality of life and rehabilitation. Elsewhere Evans and coworkers (1984b) have examined the impact of different ESRD treatment modalities and patient characteristics on the outcomes of treatment. They confirmed that patient selection factors, as evidenced by the characteristics of patients on each of the available treatment modalities, had a substantial affect on patient outcomes. Also, as described above, as ESRD patient selection criteria have been relaxed, the outcomes experienced by patients have concomitantly declined. In other words, it does not appear that all patients treated today will have the same quality of life and longevity reported for the patient population of several years ago.

In this same regard, it is expected that more relaxed criteria for heart transplant recipients may greatly jeopardize their outcomes. As older and sicker patients are transplanted, the complication rate will increase and quality of life and rehabilitation will decline. Although a complex social, legal, and ethical dilemma, there is no means by which the quality of life of all heart transplant recipients, regardless of age and medical contraindications, can be guaranteed to be similar to that of younger patients with fewer complications.

Perhaps the most profound lesson from the ESRD experience is the importance of cost. Here cost is used in a generic sense to denote program expenditures, patient expenses, and social welfare payments. The cost of the ESRD program continues to increase at a rate that pales in comparison with earlier projections. A period of leveling-off is not yet in sight, and policymakers, legislators, and other observers are unsure what the future may hold (Caplan, 1981). Whether experience with heart transplantation will be directly comparable is debatable, but in all likelihood it will be similar. Again, program cost will mirror patient input to the system. If patient selection criteria become relaxed and the patient case-mix more medically complex, overall expenditures are likely to rise.

Patient expenses, although not substantial at this time, may increase as public and private insurers limit reimbursement for various treatment-related expenses, thus increasing the share that patients must bear out-of-pocket. If patients are unable to return to gainful employment, as has been the case for many dialysis patients, such a shift in "expense-sharing" may be particularly devastating.

Finally, experience with ESRD vividly shows that treatment-related costs are only one part of total expenditures. Many ESRD patients become dependent on various government income maintenance programs, but even with these income supports are in difficult financial straits. Again, it is uncertain whether the same would hold true for heart transplant patients. On the positive side, of all ESRD patients, successfully transplanted patients are among the best rehabilitated. Probably as a result of patient selection, 46.0

percent of kidney transplant patients as opposed to 77.0 percent of in-center hemodialysis patients receive income support through federal programs (see Table 44-6, above). Also, 23.2 percent of kidney transplant recipients studied by Garrison et al. (1984) had family incomes below the poverty level, as compared with 42.0 percent of in-center hemodialysis patients. Thus, there may some reason for optimism.

In conclusion, experience has been gained and lessons have been learned from the ESRD program (Rettig, 1983; Caplan, 1981). Although this program is often criticized, it serves as a prototype of what a catastrophic health care program may entail, both administratively and operationally. It does have certain limitations for creating the kinds of analogies proposed here, and the extent to which these are recognized will greatly facilitate more general health planning efforts.

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CHAPTER 45

A PERSPECTIVE ON HEALTH CARE RESOURCE ALLOCATION AND RATIONING DECISIONS

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A. INTRODUCTION

Discussions regarding the high cost of medical care in increasing numbers now include commentaries on the possibility that the resources available for medical care must be allocated across medical care programs. While in the past, resources available for the medical needs of the nation have at least been perceived as unlimited, the appearance of numerous large and small medical technologies, and their indiscriminate use among some physicians, has thrust resource allocation decisions into the forefront (Leaf, 1984). It is questionable whether it will be possible, in the future, to redistribute to medical programs resources available for other purposes.

A picture is now beginning to emerge where, in the future, resource constraints are likely to make allocation decisions inevitable (Office of Health Economics, 1979; Anonymous, 1983; Cochrane, 1983; Schwartz and Aaron, 1984a; 1984b; Aaron and Schwartz, 1984; Faucett, 1984; Mitchell and Oliveira, 1984; Potter, 1984; Kennedy, 1984)). Consequently, the tasks of both the clinician and policymaker are likely to become more difficult (Reuben, 1984). For example, in the absence of formal resource allocation rules and the failure to test new health technology adequately and to assess its broader social implications, clinicians to an increasing degree find themselves being forced to confront problems that traditionally have been reserved for biomedical ethicists (Ramsey, 1970; Wertz, 1973; Beauchamp, 1979; Stein, 1978; Callahan, 1980; Tancredi, 1982; Clements and Sider, 1983; Gorovitz et al., 1983; Childress, 1982; Gorovitz,

1982; Francoeur, 1983). Unfortunately, clinicians are often ill-prepared to deal with complex bioethical issues. Few clinicians have previously been asked to participate proactively in the allocation, let alone the rationing, of health care resources. Many would argue that, in principle, this activity represents a conflict of interest and is contrary to the Hippocratic Oath.

Policymakers, perhaps surprisingly, seem to be equally inept at resolving ethical dilemmas. As described by myself and coworkers, this was particularly true of the End-Stage Renal Disease Program, in which it was decided that in a country where resources appeared almost limitless, the ethical and moral dilemma of selecting patients for treatment (Anonymous, 1984; Kurtzman, 1983), based on a perceived need to limit treatment, was resolved rather easily by making additional resources available to treat people with ESRD (Evans et al., 1981). In describing the process by which Medicare benefits were extended to ESRD patients, my coworkers and I concluded the following:

> ...the federal government appears to have been more concerned with ridding itself of the moral dilemma of indirectly deciding who could live and who would die in a country of almost unlimited resources. The easiest way to eradicate this problem was to treat everyone equally by making everyone eligible for the same benefits.

Today, it is now apparent that this decision has only staved off the inevitable--deciding which patients should be treated under public and private insurance programs. The prospect that such decisions may become inevitable raises a number of important medical, social, ethical, legal, and economic questions. To the surprise and chagrin of many, it is noteworthy that such decisions are not completely

foreign to the medical profession (Crane, 1975a; 1975b). Problems of medical triage and the treatment of patients in intensive care units (including neonatal intensive care) and other "high-cost" users of medical care raise similar questions (Becker, 1979; Civetta, 1973; Cullen et al., 1976; Turnbull et al., 1979; Thibault et al., 1980; Detsky et al., 1981; Martin et al., 1974; Zook et al., 1980; Schroeder et al., 1981; Silverman, 1981; Bridge et al., 1981; Bayer et al., 1983; Singer et al., 1983; Franklin, 1984; Teres, 1984; Zawacki, 1984; Adel, 1984; Nikolic, 1984; Singer et al., 1984).

Organ transplantation offers us an opportunity to consider many of these issues, and over the past eighteen months nearly every issue related to resource allocation and rationing decisions has received a remarkable amount of attention in relationship to organ transplantation (Christopherson, 1982; Calne, 1983; Caplan, 1983; Consensus Conference, 1983; Evans, 1983; Gunby, 1983a; 1983b; 1983c; Iglehart, 1983; 1984; Kolata, 1983a; 1983b; Macek, 1983; Sherlock, 1983; Shumway, 1983). Clinicians ask when it is appropriate to transplant a person with a failing heart or liver and question whether the term of survival a patient is offered is adequate given the experience they must endure. The social issues are certainly no less controversial. They concern the priorities that society bestows on complex and expensive halfway medical technologies. Of course, economics is a primary consideration. At what cost are transplant procedures performed and who will pay are the primary concerns of the health economist entering the field. It is recognized, however, that health care is not without its price, and a decision not to transplant does not reduce the cost of treating the

patient to nothing. The ethicists and lawyers are also caught entangled in a complex array of attractive yet nearly irresolvable issues. Both are concerned about who will be treated and, more importantly, on what grounds will people be excluded from treatment. Ethicists are acutely interested in questions related to the donation of human tissue and organs for purposes of transplantation, as are the legal observers. Also, students of law have confronted various issues related to antitrust as some attempts have been made to place restrictions on the providers of transplant procedures. Clearly, as these few examples illustrate, the issues with which we must grapple are extraordinarily complex.

Ultimately, therefore, we would be remiss in our analysis of heart transplantation if we did not confront directly the resource allocation and rationing issues. Other Chapters in the report have alluded to these issues, but the overall focus has been rather narrow. It is the primary objective of this chapter to bring to bear a much broader perspective, because, in most respects, organ transplantation typifies the issues that we will be asked to address increasingly.

B. LIFE EXPECTANCY, CHRONICITY, DISABILITY, MEDICAL TECHNOLOGY, AND MEDICAL CARE COSTS

The reason bioethical issues have emerged among the more predominant issues in medicine today becomes clear when one considers the increased prevalence of chronic disease, the changing age distribution of the population, notable increases in life expectancy, the increased prevalence of disability, the introduction and widespread

availability of new medical technology, and the high cost of medical care. The interrelationships among these are obvious. For example, the longer people live, the greater the likelihood that they will exhibit chronic disease, have subsequent disability, make use of new and expensive medical technology, and ultimately fall into the category of high-cost users of medical care (Cluff, 1981; Reiser, 1978; Russell, 1979; Brown, 1978; Ellison, 1978).

1. LIFE EXPECTANCY

The percentage of people over age 65 has steadily risen in all industrialized countries during the past century (McGinnis, 1982;). While the proportion of elderly in the United States has doubled since 1900, their numbers have increased sevenfold. Today, the life expectancy of males, regardless of race, is approximately 70 years, and for females, 77 years (Department of Health, Education, and Welfare, 1980). The average life expectancy for both groups is about 71 years. Overall, males are expected to outlive their earlier (1900) counterparts by 22 years, and females, their counterparts by 29 years (see Table 45-1). While the longevity of nonwhites lags behind whites, the gains achieved by nonwhites have been even more dramatic as minority life expectancy in this country has doubled.

The composition of the population is also changing. In 1950, 12.3 million people in the United States, or 8.1 percent of the total population, were older than 65 years. By 1960, this group had grown to 16.6 million persons or 9.2 percent. The number reached 23.5 million in 1977, an increase of 91.1 percent from 1950, and this figure represented 10.9 percent of the total population. It is now

Table 45-1

Life Expectancy At Birth, According to Race and Sex:
United States, Selected Years 1900-1978

	TOTAL			WHITE			ALL OTHER[1]		
YEAR	BOTH SEXES	MALE	FEMALE	BOTH SEXES	MALE	FEMALE	BOTH SEXES	MALE	FEMALE
1900[2]	47.3	46.3	48.3	47.6	46.6	48.7	33.0	32.5	33.5
1950	68.2	65.6	71.1	69.1	66.5	72.2	60.8	59.1	62.9
1960	69.7	66.6	73.1	70.6	67.4	74.1	63.6	61.1	66.3
1970[3]	70.8	67.1	74.7	71.7	68.0	75.6	65.3	61.3	69.4
1975[3]	72.5	68.7	76.5	73.2	69.4	77.2	67.9	63.6	72.3
1976[3]	72.8	69.0	76.7	73.5	69.7	77.3	68.3	64.1	72.6
1977[3]	73.2	69.3	77.1	73.8	70.0	77.7	68.8	64.6	73.1
1978[3]	73.3	69.5	77.2	74.0	70.2	77.8	69.2	65.0	73.6

[1]For 1900-1902, data for the "all other" category were for black people only.

[2]Death registration area only. The death registration area increased from 10 States and the District of Columbia in 1900 to the coterminous United States in 1933.

[3]Excludes deaths of nonresidents in the United States.

SOURCE: U.S. Department of Health and Human Services. Health: United States, 1981. DHHS Publication Number (PHS)82-1232. Hyattsville, MD, 1981.

projected that the number of people over 65 years of age will be 31.8 million by the year 2000--12.2 percent of the total population and a 157 percent increase in 50 years (Department of Health, Education, and Welfare, 1980). As the population ages, chronic disease and disability are becoming increasingly visible problems. Chronic rather than acute diseases are now the most prevalent causes of death in industrial societies (Crane, 1975b; Lerner, 1970).

2. CHRONIC DISEASE AND DISABILITY

Since the early 1900s, there has been a substantial decline in those infectious diseases that have proved to be so intractable in past years (Dubos, 1965). Heart attack, stroke, cancer, and leukemia are but a few of those retrogressive chronic diseases, often of slow insidious onset, which have replaced infections, viruses, and tubercular fatalities in the United States.

Given current available data sources, it is difficult to estimate the true prevalence of chronic disease. Few population-based epidemiological studies have been undertaken to estimate explicitly the prevalence of all chronic diseases (Commission on Chronic Illness, 1956). The Framingham Heart Study represents but one exemplary population-based epidemiological study of cardiovascular disease. Results of this study have shown the now apparent decline in the prevalence of cardiovascular disease (McGinnis, 1982; Havlik et al.; 1979; Dawber, 1980).

Other statistics on chronic disease which have been published by the National Center for Health Statistics are based on self-reported illness and disability in the Health Interview Study.

These reports indicate that in the early years of life, only about 6 out of 1,000 people endure chronic conditions. During young adulthood (age 25 or so), the rate increases to 35, and by the fourth decade that figure has almost tripled to 100 people out of every 1,000. By age 65 this number has again doubled and then doubled yet another time after age 75, until almost 90 percent of all people older than 90 years live with a chronic illness (Hendricks et al., 1977). Again ignoring the age factor, it has at times been estimated that approximately 50 percent of the civilian population, excluding residents in institutions, have one chronic condition or more (Strauss, 1975). As for the number of chronic conditions per person, one study has shown this to be 2.2 (Strauss, 1975).

It is currently estimated that 80 percent of health care resources in the United States, including facilities, services, and biomedical research, are now devoted to chronic disease (Cluff, 1981). During 1978, an estimated 10.3 million persons, or 45 percent, of the civilian population age 65 and older not residing in institutions were reported in health interviews to have some degree of activity limitation caused by chronic disease or impairment (see Table 45-2) (Givens, 1979). Of these 10.3 million persons, fully 85.2 percent indicated that they were limited in or unable to carry on major activities, affecting their ability to work or manage a household (Givens, 1979). The remainder were limited but not in major activity.

Ignoring the age factor, 30 million Americans (14 percent of the total population) were reported to have dysfunction caused by

Table 45-2
Number and Percent Distribution of Persons with Limitation of Activity Due to Chronic Conditions, By Degree of Limitation According to Age: United States, 1978.

AGE	TOTAL POPULATION	WITH ACTIVITY LIMITATION	LIMITATION IN MAJOR ACTIVITY	WITH NO ACTIVITY LIMITATION	TOTAL POPULATION	WITH ACTIVITY LIMITATION	LIMITATION IN MAJOR ACTIVITY	WITH NO ACTIVITY LIMITATION
BOTH SEXES	NUMBER IN THOUSANDS				PERCENT			
ALL AGES ----	213,828	30,306	22,598	183,523	100.0	14.2	10.6	85.8
UNDER 17 YEARS----	59,012	2,309	1,178	56,703	100.0	3.9	2.0	96.1
17-44 YEARS-------	88,627	7,501	4,621	81,126	100.0	8.5	5.2	91.5
45-64 YEARS-------	43,403	10,244	8,063	39,159	100.0	23.6	18.6	76.4
65 YEARS AND OVER-	22,788	10,252	8,736	12,535	100.0	45.0	38.3	55.0

SOURCE: Givens, JD: Current Estimates from the Health Interview Survey. Vital and Health Statistics, Series 10, Number 130. DHEW Publication No. (PHS)80-1551. Hyattsville, MD: National Center for Health Statistics, 1980, Table 1.

chronic diseases, and, of these, 23 million, or 74.6 percent, were limited in or unable to carry on major life activities, affecting their ability to work, manage a household, or attend school (Givens, 1979).

3. MEDICAL TECHNOLOGY

Over the years medical technology has been most successful in dealing with infectious diseases. Thomas (1974; 1977), in his analysis of technology notes that much of the technology germane to the treatment of infectious diseases "comes from a genuine understanding of disease mechanisms, and when it becomes available, it is relatively inexpensive, relatively simple, and relatively easy to deliver." This technology is exemplified by modern methods for immunization against diptheria, pertussis, and the childhood virus diseases and the contemporary use of antibiotics and chemotherapy for bacterial infections (Banta, 1981). Other examples cited by Thomas (1977) include the treatment of endocrinologic disorders with appropriate hormones, the prevention of hemolytic disease of the newborn, and the treatment and prevention of various nutritional disorders.

Major technological advances, however, have been made specifically for treating incurable chronic diseases, many of which have varying implications for the level of functional ability patients are able to regain. Since many of these interventions do not cure disease, they are frequently referred to as "halfway technologies" (Thomas, 1977; Banta, 1981), and the extent to which a patient is able to cope and regain maximum function becomes all important. As

described by Crane, technological changes have affected the very character of illness, permitting the physician to have greater control over the process of dying and the timing of death (Crane, 1975b). She also notes that in less obvious ways, improvements in medical technology have produced increasing levels of disability in western society (Ford, 1970). Moreover, technology has permitted the survival of more or less severely disabled persons such as diabetics and infants with myelomeningocele who would otherwise have died.

It is now estimated that each year, hundreds, perhaps thousands, of new technologies enter the medical care system. These include drugs, procedures, devices, and instrumentation, all constituting preventative, diagnostic, and therapeutic tools (Office of Technology Assessment, 1978; Editorial, 1983). Many of these technologies have undoubtedly contributed to the substantial improvement in the health status of the American people. Also, relief of pain, amelioration of symptoms, and rehabilitation now have become possible for many patients with diseases that cannot be successfully prevented or treated (Office of Technology Assessment, 1978). The benefits of medical technology, in some instances, have been found to be more apparent than real (Larson, 1981). For example, various inefficacious procedures have been practiced and then abandoned in this country. These include gastric freezing for peptic ulcer, colectomy for epilepsy, hypogastric artery ligation for pelvic hemorrhage, sympathectomy for asthma, internal mammary artery ligation for coronary artery disease, adrenalectomy for essential hypertension,

and wiring for aortic aneurysm (Banta, 1981; Larson, 1981; Hiatt, 1975; Preston, 1977; Fineberg, 1979).

While efficacy and safety (that is, medical technology's medical benefits and risks) have traditionally been the primary focus of health technology assessment, (Banta, 1981; Office of Technology Assessment, 1978; Bunker et al., 1978; Banta et al., 1981; Banta et al., 1978; Schwartz et al., 1978; Arnstein et al., 1975) attention has begun to focus on other aspects of health care technology (Wagner, 1979a; 1979b). For example, on June 12, 1980, Patricia Roberts Harris, then Secretary of the U.S. Department of Health and Human Services (DHHS), announced that new health technologies must be evaluated not only on the basis of their medical efficacy and safety but also on the basis of their "social consequences" before "financing their wide distribution" (Knox 1980), As noted by Knox, the approach being suggested by Harris was even more comprehensive than that used by, for example, the Environmental Protection Agency (EPA) in dealing with pesticides, the Food and Drug Administration (FDA) in its treatment of pharmaceuticals, and the Occupational Safety and Health Administration's (OSHA) approach to carcinogens in the work place (Knox 1980; Brooks et al., 1970; Coates, 1981; Gordon, et al., 1975; Morrison, 1981). New health technology was to be evaluated concerning its cost-effectiveness, cost-benefit ratios, its ethical implications, and its "long term effects on society." The all encompassing intent of technology assessment has been characterized by Banta and Behney (1981) as follows:

> Technology assessment is seen as a comprehensive form of policy research that examines short- and long-term social consequences (e.g., societal, economic, ethical, legal) of the application of technology. Technology assessment is an analysis of primarily social rather than technical issues, and is especially concerned with unintended, indirect, or delayed social impacts.

It is now becoming more evident that the assessment of any emerging or existing technology must, at least, include consideration of the following parameters:

(1) the potential need for the procedure, device, instrument, or drug

(2) the relevant constraints on the availability of the technology (e.g., absence of donor organs for transplantation, location of treatment facilities, shortage of trained personnel)

(3) the cost-effectiveness/cost-benefits of the technology assessed in terms of both economic and social costs, including lives saved

(4) the legal issues pertaining to the adoption and availability of the technology, including risks associated with its use (e.g., where will the technology be made available, who is eligible to receive the technology, what risks does the recipient incur in the use of the technology?),

(5) the ethical issues concerning the selection of recipients of the technology, the allocation of resources to health care programs, and individual patient rights to health care regardless of cost and availability.

Failure to consider these issues will make it extraordinarily difficult to anticipate the long-term implications of any emerging or existing technology (Stocking 1978; Committee on Technology and Health Care, 1979; Goldman, 1979; Frazier et al., 1978).

4. COST OF MEDICAL CARE

In 1980, expenditures for medical care consumed 9.4 percent of the gross national product (GNP) (Gibson et al., 1981). In this same year, health care spending increased by 15.2 percent, representing a moderate acceleration over the 12.5 percent increase during 1979. This figure is substantially higher than the 13.4 percent growth rate between 1978 and 1979 and is certainly much higher than the average of 12.2 percent annually over the period 1965 to 1979 (Gibson et al., 1981). GNP increases have averaged 9.2 percent per year for the same period. This substantially greater growth rate in the health care sector compared to the rest of the economy resulted in the health care share of the GNP rising from 6.1 percent in 1965 to the 9.4 percent level seen today. Between 1950 and 1978 alone, in the United States, total annual expenditures for health care and other forms of health-related activities increased 1,500 percent (Herrell, 1980). In 1950, medical care expenditures constituted 4.5 percent of the U.S. gross national product.

In analyzing these increased health expenditures, it is obvious that third party payers have, in many respects, contributed to the rise in health care costs, primarily because they have traditionally placed few constraints on expenditures. In 1979, personal health care funds supplied by third parties amounted to $147.0 billion of the $217.9 billion in personal health expenditures, or 68 percent (Gibson et al., 1981). Federal, state, and local governments financed the largest portion of that amount--about 40 percent of the total. Private health insurance payments covered an

additional 27 percent of personal health care. In 1980, private insurers, including Blue Cross and Blue Shield plans, commercial insurance companies, and independent plans, paid benefits amounting to $58.1 billion, or 27 percent of personal health care expenditures. In 1980, approximately 76 percent of the U.S. population was covered by private hospital insurance (Gibson et al., 1981).

Often the cost of disability is ignored as a health-related factor. This is somewhat misleading, since every chronic disease requires a certain level of expenditure for medical care, but, at the same time, the person may be disabled and, consequently, draws upon disability programs for various cash benefits. The total cost of illness should reflect not only actual medical treatment costs but the cost of services and other benefits the person receives because of his illness (Evans, 1982; Rice, 1966a; 1967a; 1967b; Rice et al., 1981; 1982; Cooper et al., 1976; Landefeld et al., 1982).

Table 45-3 shows a complete breakdown of government expenditures for illness-tested welfare programs for fiscal year 1975. As shown here, in 1975, cash payments to disabled persons under these public programs amounted to over 23 billion dollars. The growth of the disability program is also interesting. As noted by Stone (1979), disability benefits administered through the Social Security program, although smaller than retirement benefits in total dollar amount, are increasing at a much higher rate, and the number of disability beneficiaries is also growing faster than the number of retirement beneficiaries (see Table 45-4). A close examination of the Supplemental Security Income program presents a similar picture--

Table 45-3
Government Expenditures for Illness-tested
Welfare Programs for Fiscal Year 1975
(in billion dollars)

PROGRAM	AMOUNT		
	FEDERAL	STATE-LOCAL	TOTAL
Disability Insurance (SSA)	$ 7.6	-	$ 7.6
Civil Service Disability	1.4	-	1.4
Railroad Disability	0.2	-	0.2
Black Lung Benefits	0.6	-	0.6
Uniform Services			
VA and military disability	4.7	-	4.7
Other (income-tested)	0.5	-	0.5
Temporary Disability Insurance	-	0.9	0.9
Workman's Compensation	1.3	3.2	4.5
Public Assistance			
SSI-disabled	2.3	-	2.3
AFDC (disabled male head of household)	0.6	-	0.6
TOTAL			$23.3*

*Total does not include payments made through various private insurance arrangements, nor does it include payments made for medical services.

SOURCE: Stone, D.A. Illness in American Politics. Journal of Health Politics, Policy, and Law. 4(3):509, 1979. Also see A. Skolnik and S. Dales, "Social Welfare Expenditures, Fiscal Year 1976," Social Security Bulletin 40:3-19, 1977 (January).

Table 45-4
Growth of Disability and Retirement Programs Under OASDHI, 1965-1979

PROGRAM	NUMBER OF BENEFICIARIES (in millions) 1965	1979	PERCENT INCREASE	AMOUNT OF BENEFITS (in billions) 1965	1979	PERCENT INCREASE
RETIREMENT	13.9	22.4	61%	$12.5	$59.3	374%
DISABILITY	1.7	4.8	182%	$ 1.6	$12.5	681%

SOURCE: U.S. Department of Commerce, Bureau of Census, Statistical Abstract of the U.S. 1981 (Washington, DC: Government Printing Office, 1981), Table 526.

federal payments to disabled persons grew by 13.6 percent between 1977 and 1980, as compared with an increase of only 8.0 percent in payments to the aged (see Table 45-5).

The rapidly rising costs of health care have served to spur interest in health care technology assessment (Banta et al., 1981; Hiatt, 1975; Scitovsky, 1967; Russell, 1976; Egdahl et al., 1978; Fineberg, 1979; Relman, 1980). Recently much blame has been placed on health care technology as the "culprit" behind high health care costs (Bunker et al., 1982a; 1982b; Altman et al., 1979; Moloney et al., 1979; Gaus et al., 1979; Marks, 1979; Heyssel, 1979; Bennett, 1977; Blendon et al., 1979; Showstack et al., 1982; Feldstein et al., 1977; National Commission on Cost of Medical Care, 1978; Davis, 1974). Although the total contribution of new technology to rising costs is controversial, estimates of the effect of technology on increased per diem hospital costs range from 33 percent to 75 percent, with 50 percent being an average figure (Banta et al., 1981; Larson, 1981; Feldstein et al., 1977; Davis, 1974; Waldman, 1972; Worthington, 1975). Detailed case studies have been undertaken that illustrate the variable effect of technology on the treatment of chronic disease (Larson, 1981). Scitovsky and McCall (1976), for example, looked at the changing cost of treating 11 different conditions at the Palo Alto Medical Clinic over a period of several years. They found the real cost of treating five conditions fell while the cost of treating six actually increased. Closer examination of these six conditions showed that there had been a notable increase in the use of diagnostic tests and therapeutic procedures per diagnosis. Laboratory tests per case

Table 45-5
Growth of Expenditures Under Supplemental Security Income
1979-1980

CATEGORY	FEDERAL PAYMENTS (in billion dollars) 1979	1980	INCREASE
AGED	$2.5	$2.7	8.0%
DISABLED	$4.4	$5.0	13.6%

SOURCE: U.S. Department of Commerce, Bureau of Census, Statistical Abstract of the U.S. 1981 (Washington DC: Government Printing Office, 1981), Table 560.

of perforated appendicitis rose from 5.3 in 1951, to 14.5 in 1964, to 31.0 in 1971. Inhalation-therapy procedures for myocardial infarction rose from 12.8 per case in 1964 to 37.5 in 1971 (Banta et al., 1981; Larson, 1981; Scitovsky et al., 1976).

Fineberg and Hiatt have noted that, for several reasons, rising medical costs can be attributed to technology (Fineberg et al., 1979). First, although the trend is toward shorter hospital stays, this is accompanied by an increased consumption of resources during hospitalization. Second, more advanced equipment design may improve efficiency, but, with increased use of the equipment and other "induced costs," potential savings are never realized. Third, many new technologies do more than simply perform old services more efficiently, they provide new and expensive services. The intensive care unit, for example, is but a single innovation that in 1974 was found to account for 10 percent of all hospital costs (Russell, 1976).

It is often argued that big, expensive technologies contribute disproportionately to the high cost of medical care, although the costs and benefits of a new technology largely depend on how and to which patients it is applied (Fineberg et al., 1979; US Department of Commerce, 1981; Stoughton, 1982). Moloney and Rogers (1979), however, have argued that the big and highly visible technologies such as the computed tomographic scanner "...actually account for far less of the annual growth in medical expenditures than do the collective expense of thousands of small tests and procedures that are more frequently used by physicians and that individually cost little."

The use of a technology is directly related to reimbursement for its use (Bunker et al., 1982a; Banta et al., 1981; Stoughton, 1982; Derzon, 1982; Schroeder et al., 1978). Moloney and Rogers (1979) suggest that one approach, although problematic, to slowing the use of a technology is to develop protocols "...that instruct physicians to use technologies only when less expensive methods cannot provide adequate information on patient care; limit reimbursement to use according to these standards." At present, policies with regard to the reimbursement of new technologies, if they exist, are often inconsistent. Under the Medicare program, the major reason for excluding a technology for reimbursement is when it has not been demonstrated to be safe and effective (Greenberg et al., 1981; Towery and Perry, 1981). As described by Bunker and associates (1982a), "...the government's reimbursement policy has been left largely to the commercial and nonprofit carriers to whom the government, by contract, has delegated the responsibility for processing claims." To accomplish this objective, some carriers, such as California and Massachusetts Blue Shield, have organized their own technology assessment committees and procedures. California Blue Shield has only recently placed limitations on procedures that are considered experimental. Previously, the carrier was committed to reimbursing for services that were "reasonable and necessary" (Bunker et al., 1982a). At present, there appears to be no satisfactory uniformly applied approach to limiting the growth of technology through alternative reimbursement policies.

Controlling the growth and distribution of technology is complicated by the fact that the medical technology industry is large and multinational (Banta et al., 1981; Gordon et al., 1975; Elliott et al., 1976). To slow its growth through regulation surely would have a multitude of political ramifications. Since World War II, the medical technology industry has experienced dramatic growth in sales, firms, and establishments (see Table 45-6) (Wenchel, 1981). Wenchel attributes much of the growth to the increased demand for health services supported by private, voluntary, health insurance and government programs such as Medicare and Medicaid, Hill-Burton, and Regional Medical Programs (Wenchel, 1981). The roentgenography and electromedical industries have seen the greatest increase in sales, showing an increase of $1.8 billion million, between 1958 and 1977. Consequently, it is difficult to imagine that the medical technology industry is willing to sit idle as new regulations are introduced to slow the growth of technology. Perhaps this is most true in those situations where existing rather than emerging technologies are being scrutinized.

C. A SUMMARY PERSPECTIVE

The foregoing discussion points to several problems and developments which indicate the inevitability of resource allocations to health care programs. The U.S. population is aging; chronic disease is becoming more prevalent, disability a common occurrence. To meet the needs of an aging, chronically ill, and disabled population, a complex array of expensive and sophisticated medical

Table 45-6
Growth in the Medical Technology Industry

	1958	1977
Sales, billion dollars	1.0	8.1
No. of companies	1,366	1,442
No. of establishments	2,802	3,203

SOURCE: Wenchel HE, A Summary of the Study of the Medical Technology Industry. Contract No. 233-79-3011. Hyattsville, MD: National Center for Health Services Research, 1981.

technologies has emerged. The cost of these technologies will make it necessary to develop elaborate plans to not only enable them to be used but to insure that people receiving them derive the maximum expected benefits. Thus, it is apparent that resource allocation decisions are likely not only to become a necessity but to become routine (Cooper, 1977; Katz et al., 1975).

In short, in the future, the demand for health care will doubtlessly outstrip available resources (Golding et al., 1980; Mushkin et al., 1979). The problem then becomes one of determining how to best allocate the available resources to optimize the health of the population. To accomplish this objective, it will be necessary to study carefully new and existing technology to determine the magnitude of potential benefits (Bunker et al., 1982a; 1982b; Banta et al., 1981; Banta et al., 1978). At the same time, it will be necessary to increase the efficiency of the existing health care delivery system in an attempt to ensure that maximum benefits are being derived (Cochrane, 1971). During this process, it is probable that some types of medical care can no longer be provided, or, if provided, they will be done so on a limited basis since the derived benefits are too costly for all to benefit. The question then becomes one of determining the best method of implementing allocation decisions (Acton, 1978; Jones-Lee, 1976). In doing this, it subsequently will become necessary to ration care within health care programs that have been spared from complete extinction. Although advanced technology will provide many persons with a new lease on life, not all are expected to benefit equally, if at all. As these allocation and rationing exercises are undertaken, a

new appreciation of medical ethics will come about, accompanied by a more careful assessment of the nature of death and dying within this society (Fox, 1974; 1979). These issues as they apply to this analysis are more completely delineated below.

D. ALLOCATION AND RATIONING OF HEALTH CARE RESOURCES

Of all the resource-shortage crises this nation is expected to confront in the future, the problem of resource distribution is likely to be most acute and problematic in medicine (Becker, 1979; Martin et al., 1974; Rescher, 1969). Persons will be recognized as in need of, and then denied, benefits that the medical care delivery system is capable of providing. Instead of an unidentified mass of individuals being denied access to a needed resource, persons whose names have become known to the public will be declared ineligible for a treatment or service they are known to require (Schelling, 1968). Perhaps this scenario is inhumane, but it is undoubtedly a true representation of reality. As already noted, technology now permits to be saved the lives of persons who less than a decade ago would have surely died. Moreover, technology has made it exceedly difficult to specify at precisely what point life ceases. This has prompted Crane to conclude that both medicine and law are moving toward a "social interpretation" of life (Crane, 1975b).

It should come as no surprise that the resources available to meet the demand for health care are limited (Fuchs, 1974; Weinstein et al., 1976; 1977; Weinstein et al., 1980; Stason et al., 1977; Weinstein 1980). Weinstein and Stason (1977), for example, have pointed out

that decisions are already being made--physicians allocate their time, hospitals ration beds, fiscal intermediaries devise reimbursement policies--all of which suggest that priorities are being set. This is not to deny the recency of problems associated with resource constraints. Even a few decades ago, before the proliferation of medical technology and the pervasiveness of insurance, constraints on health care resources were largely unheard of. In the past, the distribution of health care resources has been accomplished by implicitly limiting their availability or when available, restricting people's access to them (Mechanic, 1977). Thus, the concepts of availability and accessibility are critical to the problem of resource distribution (Mechanic, 1978; Aday et al., 1975). Rationing is the term often used to describe the process of differentially distributing resources. Rationing has become a value-laden term--one which implies that people are likely to be treated unequally (Childress, 1797). Allocation is another term often used to describe the unequal distribution of resources. While Webster's New World Dictionary defines rationing as "a fixed portion; share; allowance," allocation is to "set apart for a specific purpose, to distribute according to a plan."

As suggested by the definitions of rationing and allocation, there is merit in distinguishing between the allocation and the rationing of health care resources. Others have used the terms macroallocation and microallocation to make a similar distinction (Childress, 1979; Blumstein, 1981). Regardless of the terms used, it should be recognized that allocation and rationing differ with regard to

temporality and level. First, allocation decisions are likely to precede rationing decisions. Second, allocation is a concept that does not apply well at the level of the individual patient but rather is more appropriately applied at the aggregate or health care program level.

In a period when resources available for health care have become increasingly constrained, attention is directed toward making the delivery of health care more efficient. For example, although much attention has recently focused on the enormous cost of the End-Stage Renal Disease Program, the question being addressed is not whether or not patients should have their Medicare benefits cut off but rather on how treatment can be provided at less cost.* Thus, the debate over which type of therapy (primarily home or in-center dialysis) is least costly is again being hotly debated (Kusserow, 1982; Iglehart, 1982; Relman, 1980; Rettig, 1980a; 1980b; Kolata, 1980a; 1980b; Lowrie et al., 1981; 1982; Hampers et al., 1979; Blagg, 1979). At the same time, there is renewed interest in methods by which donor organ availability can be increased (Bart et al., 1979; Bart et al., 1981; Bart et al., 1981; Steinbrook, 1981;). Recent hearings once again have indicated that home dialysis is probably less costly than in-center dialysis but that kidney transplantation is a greater bargain since not only is the cost lower in the long run, but the

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*The total cost of the kidney program in fiscal year 1982 is expected to be $1.8 billion. Stated in other terms, ESRD patients, representing less than a quarter of a percent of all Medicare Part B beneficiaries, now account for more than nine percent of total Medicare Part B expenditures (Davis, 1982).

quality of life of renal transplant recipients is generally thought to be better than that of dialysis patients (Simmons et al., 1974; Simmons et al., 1977; Poznanski et al., 1978; Guttmann, 1979). Since there seems to be room for improving the provision of end-stage renal disease services, there is only minimal consideration being given to reduction or discontinuation of benefits that patients with renal disease currently receive. Thus, resources will continue to be allocated to the End-Stage Renal Disease Program but, in the future, greater attention will focus on the intraprogram allocation of resources. It will be expected that the agency responsible for administering the program, the Health Care Financing Administration (HCFA), will write regulations which will maximize the use of those resources made available to the program; that is, the HCFA will be expected to promote the least costly treatment modalities by providing incentives for their adoption (Iglehart, 1982).

In England, of course, the situation is quite different as there is a real shortage of dialysis stations and persons generally over 55 years of age are denied life-saving maintenance dialysis. This denial, however, is accomplished when general practitioners fail to refer patients with ESRD to nephrologists (Schwartz and Aaron, 1984a; Aaron and Schwartz, 1984; Davison et al., 1984; Heath, 1984; Douglas, 1984; Wing, 1983; Brahams, 1984; Iglehart, 1983; 1984).

Should the resources available for health care become increasingly constrained in the U.S., the Department of Health and Human Services will be put in a position where interprogram allocation decisions will become necessary. These allocation decisions would concern how to

distribute resources across health and, perhaps, social and other publicly financed programs. For example, a question might be raised as to whether the resources currently used to treat kidney disease might better be allocated to prevention activities or to a maternal and child health care program where the derived benefits are likely to surpass those currently received by patients with ESRD (Hiatt, 1975). In the future, competition for the available resources is likely to be great. The high cost of some new technologies might well make their widespread use prohibitive. Should this prove to be the case, it will then be necessary to consider the rationing of resources within health care programs.

Resources are rationed at the individual level, while allocation occurs at the aggregate level. Once it is apparent that all who are in need cannot be treated, the question then becomes one of which potential recipients are going to derive the greatest benefits. Again, this is precisely what occurred during the early years of dialysis, when there was substantial patient selection by physicians or committees. At that time, it was decided that although all ESRD patients had a terminal condition, some had better prospects for treatment than others (Evans et al., 1981; Fox et al., 1974)). The preferred candidates were selected on the basis of a variety of criteria (e.g., age, medical suitability, mental acuity, family involvement, criminal record, economic status), employment record, availability of transportation, willingness to cooperate in the treatment regimen, likelihood of vocational rehabilitation, psychiatric status, marital status, educational background,

occupation, and future potential (Evans et al., 1981; Fox et al., 1974; Abram, 1972; Katz et al., 1969). These criteria served as the basis upon which scarce resources were rationed. Similar criteria currently are used to select potential heart transplant recipients and, thus also serve as a rationing mechanism (Newman, 1981; Pennock et al., 1982; Copeland et al., 1981; Oyer, 1980). The decision to extend Medicare benefits to patients with ESRD resolved the rationing problem for the federal government. However, as noted by myself and coworkers, the federal government "...appears to have been more concerned with ridding itself of the moral dilemma of indirectly deciding who could live and who would die in a country of almost unlimited resources" rather than simply trying to deal with the more general problem of costly medical care (Evans et al., 1981).

Now that the federal government is at least willing to entertain the possibility of differentially allocating resources to health care programs, it inevitably will also have to entertain the need to ration health care resources once interprogram allocation has occurred and the efficient use of available resources is maximized. Should resources be constrained further and no greater efficiency attained, it would become necessary to ration the available resources to certain individuals based on some uniform set of guidelines.

The foregoing raises two important questions which have yet to be addressed: (1) On what basis will resource allocation decisions be made? (2) How are criteria for rationing likely to be developed?

E. ESTABLISHING CRITERIA FOR EXPLICIT RESOURCE ALLOCATION.

In the medical literature one increasingly finds medical procedures, practices, and technology subjected to what is commonly referred to as "cost-effectiveness and cost-benefit analysis" (Banta et al., 1981; Weinstein et al., 1976; Weinstein et al., 1977; Weinstein 1980; Stason et al., 1977; Weinstein, 1980; Bunker et al., 1977; Fuchs, 1980; Lashof et al., 1982; Warner et al., 1982). Although the two are related, they are quite different approaches to the assessment of health practices and technology. Nevertheless, both cost-effeciveness analysis (CEA) and cost-benefit analysis (CBA) are presented as tools which can be used by the policymaker to make resource allocation decisions.

A CBA or a benefit-cost analysis requires that both costs and benefits are assigned monetary values (Fineberg et al., 1981). Various methods have been proposed to measure the resource value of health care benefits. These include, for example, expected productivity loss based on discounted future earnings at the age of death or disability (Cooper et al., 1976; Klarman, 1974; Evans et al., 1982). The benefit-cost framework thus converts decreased deaths and disability into increases in productivity and treats them as the indirect benefits of a health intervention. Thus, indirect benefits are then combined with any direct savings in health resource consumption (the direct benefits) to yield a net value.

A CEA, unlike a CBA, does not require that both costs and benefits be assessed in monetary terms. Instead, the aim of a cost-effectiveness analysis is to measure benefits in nonmonetary

terms using mortality, morbidity, or quality-adjusted life years. To this extent, a CEA preserves a sense of intangible health care benefits, whereas a CBA typically notes these but fails to assess them (Fineberg et al., 1981). A CBA is particularly useful for comparing alternative approaches to the treatment of a given medical condition. For example, in-center hemodialysis, home hemodialysis, continuous ambulatory peritoneal dialysis (CAPD), and kidney transplantation all represent alternative approaches to the treatment of ESRD. A CEA allows one to compare these treatments to determine which provides the greatest benefits at the least cost (Evans et al., 1982). Similarly, heart transplantation might be compared with its alternative--traditional medical and surgical management--as approaches to the treatment of end-stage cardiac disease (Evans, 1982). Finally, percutaneous transluminal coronary angioplasty might be compared with coronary artery bypass surgery as alternative approaches to the treatment of atherosclerosis (Gruntzig, 1979; Levy et al., 1979). In all these instances, the goal of a CEA is the same--to determine which treatment approach to a given condition yields the greatest benefits at the least cost.

Both CEA and CBA can be applied on a larger scale than described herein. This application is critical to both intraprogram and interprogram allocation decisions. A CEA can be used to compare the benefits derived from various health care programs to determine which program (not specific treatment approach) yields the greatest benefit at the least cost, provided the benefits of each program being compared are expressed in the same terms (M.C. Weinstein, Ph.D.,

written communication, April 14, 1982). For example, kidney dialysis can be compared with heart transplantation to see which has the greatest benefits, with benefits expressed in terms of mortality, morbidity, or quality-adjusted life years. Weinstein describes this process as follows:

> The comparison of cost-effectiveness ratios serves as a basis for allocating resources if the objective is to maximize health benefits. Thus, if kidney dialysis has a cost-effectiveness ratio (relative to the next best alternative for ESRD) of $60,000 per quality-adjusted life year, and cardiac transplant has a cost-effectiveness ratio (relative to the next best alternative for ESCD) of $50,000 per quality-adjusted life year, then resources should be allocated to the latter ahead of the former.

In this case, the proposed interprogram analysis strictly applies to health care programs. Another pertinent example might be to compare the cost of a potential maternal and child health program with the End-Stage Renal Disease Program or a potential ESRD program.

If the goal of the interprogram analysis is to compare the expenditure of health care resources with other socially desirable uses of resources, such as a public assistance program, a cost-benefit analysis is appropriate. Within the CBA framework, all expenditures and benefits are converted to monetary terms, which permits direct comparisons to be made among various diverse programs. The results of such an analysis may indicate that resources should be reallocated from social and other publicly financed programs to support health programs and vice versa. The problem with the CBA framework, however, is the requirement that human lives and quality of life be valued in dollars (Mushkin et al., 1979; Weinstein et al., 1977).

Ultimately, the major objective of an interprogram analysis which involves only health programs or health and other publicly financed programs is to ensure that those programs which produce the greatest benefit will be those that receive the greatest support from the federal government. In this regard, it is apparent that, given limited resources and a need to allocate them in the most effective manner possible, a CEA or a CBA allows programs to be ranked according to their effectiveness or benefits derived or both. Weinstein and Stason (1977) have summarized how this is done in the case of CEA as follows:

> Alternative programs or services are then ranked from the lowest value of the cost-effectiveness ratio to the highest, and selected from the top until available resources are exhausted. The point on the priority list at which the available resources are exhausted, or at which society is no longer willing to pay the price for the benefits achieved, becomes society's cut-off level of permissible cost per unit effectiveness. Application of this procedure ensures that the maximum health benefit is realized, subject to whatever resource constraint is in effect.

Thus, it is now possible to see that the allocation of health care resources and resources available to other programs as well can be subjected to a formalized set of procedures. By requiring that all assumptions are clearly stated, it is possible to perform the necessary quantitative analyses required to make the appropriate allocation decisions. In those areas where the data are least secure, it is possible to undertake sensitivity analyses to explore further the impact of decisions under differing assumptions.

Table 45-7 summarizes which type of analysis can be applied to various allocation decisions. If possible to achieve, a CEA should be the method of choice. In only one instance is it likely that a CEA would be inappropriate. This is in the case where an interprogram analysis is required to compare health program expenditures and benefits with non-health-related program expenditures and benefits. In this case, it would be necessary to express in monetary terms the benefits derived from the program. If an intraprogram allocation decision is required, a CEA should always be the method of choice, while, in principle, both a CBA and CEA could be applied to making an interprogram health allocation decision.

F. ESTABLISHING CRITERIA FOR EXPLICIT RATIONING

The resource rationing problem is quite different from the resource allocation problem. Although, in many respects, allocation decisions set the parameters and constraints within which rationing occurs, it is somewhat more difficult to submit the rationing process to a formalized set of procedures. The literature on clinical decision-making, although not solely intended to be a framework for rationing, does provide an excellent framework with which to view rationing.

Once resources have been allocated to programs, and should these not be sufficient to meet the demand of all in need, clinicians are left with the problem of deciding which patients to treat (Buck, 1981; Mazzarella, 1981; Parsons et al., 1980; Basson, 1979; Linzer, 1984; Beauchamp and McCullough, 1984). The problems that were faced in the

Table 45-7
Applying Cost-Effectiveness and Cost-Benefit Analysis
To Program Allocation Decisions

TYPE OF DECISION REQUIRED	COST-EFFECTIVENESS ANALYSIS	COST-BENEFIT ANALYSIS	METHOD OF CHOICE
Intraprogram Allocation Decision	YES	YES	CEA
Interprogram Health Allocation Decision	YES	YES	CEA
Interprogram Health versus Other Publicly Financed Program Allocation Decision	NO	YES	CBA

CEA = Cost-effectiveness analysis
CBA = Cost-benefit analysis

early days of kidney dialysis already have been described pointing to obvious problems with any system which basically discriminates among people in the distribution of health care resources (Childress, 1970; Caplan, 1981). According to many, all people have a "right to health care" and, in a country as wealthy as the United States, no one should go untreated (Arrow, 1963; Mechanic, 1974; Krause, 1977; Strickland, 1972; Klarman, 1965; Fried, 1976; Sidel, 1978). Yet, people often fail to recognize that with every right there also is an obligation (Bell, 1979; Knowles, 1977). People have a responsibility, an obligation as it were, to care for themselves in a manner that will maximally insure good health (e.g., eat a good diet and exercise daily). Unfortunately, a vast majority of the population fails to fulfill its end of the "social contract" and chooses to engage in practices and behavior which are known to be detrimental to their health (e.g., excessive smoking, drinking, eating, and failure to exercise). Therefore, it could be argued that if everyone has a right to health care, then appropriate contracts should be drawn up to insure that everyone keeps their end of the bargain (Bell, 1979). This, of course, would require regulatory reform and strict enforcement, something which would be difficult and costly to undertake. Recently some have advocated, for example, that private insurers should recognize that people can do much to reduce their health risks and, therefore, their insurance premiums should reflect their lifestyle (Stokes, 1983a; 1983b; Swerts, 1983; Moore, 1983). Nonsmokers may, for example, be offered insurance with lower premiums (Pickering, 1983; Gullick, 1983; Lockhart-Mummery, 1983). Ultimately,

however, the limits of the broad humanistic concept of a right to health care must be recognized. Within the context of rationing, those persons who have done the most to preserve their health could conceivably be the first to benefit from the available resources (Knowles, 1977).

The problem grows in complexity when it is recognized that the final decision concerning the rationing of resources will be the shared responsibility of the clinician or medical team, the patient, and any other representative of the patient (e.g., family or nearest of kin) (McCarthy et al., 1981). It is unlikely that explicit exclusion criteria will be developed which are equally palatable to all involved (Winslow, 1982; Brent, 1983). Thus, any criteria for rationing would be interpreted and practiced by individual clinicians (Bell, 1982; Childress, 1982; Harron et al., 1982). This is consistent with the concept of the "clinical mentality" advanced by Freidson which suggests that clinicians see each patient as a special case and treat them accordingly (Freidson, 1970). Medical practice is typically occupied with the problems of individuals rather than of aggregates or statistical units. To impose a set of rationing criteria which must be strictly adhered to implies that patients need not be considered as unique individuals, but rather as aggregates. This would, in fact, represent a radical restructuring of the process of rendering clinical judgment (Feinstein, 1967).

In the final analysis, it is possible to establish some general guidelines on, perhaps, a condition by condition basis, to be applied to decide whether or not a patient should be treated (Lo et al.,

1980). The problem, however, is that all cases will have to be reviewed individually, with explicit attention given to the manner in which each patient deviates from the guidelines. These decisions are likely to be made when any of the following conditions are met: (1) the treatment is determined to be futile, (2) the patient declines treatment, (3) the quality of the patient's life is unacceptable, or (4) the cost of providing care is too great (Lo et al., 1980; Wong et al., 1981). In evaluating each case, what people decide to do will be subject to considerable variability. What is presented as a formal policy may be informally practiced in a variety of ways. Policy and practice can differ remarkably.

As described here, rationing is the process by which criteria are applied to selectively discriminate among patients who are eligible for resources that have been previously allocated to various programs. Rationing criteria, although conceivably developed at the aggregate level, are likely to be interpreted and implemented at the individual level. Thus there are two major problems associated with rationing. These are: (1) the development of acceptable criteria for withholding treatment on a condition-by-condition basis and (2) identifying that person or those persons who should make the decision not to treat.

Childress (1979) in his discussion of rationing, has distinguished between what he refers to as "rules of exclusion" and "rules of final selection." The first set of rules establishes the pool from which the final selections are made. The final selections are then based on the rules of final selection. Childress (1979) provides the following advice:

> ...the best approach to determining the pool for final selection is to forget that the resource is limited and to exclude only those patients whose medical and psychological condition would certainly prevent successful treatment.

The rules for final selection, however, are more controversial. Major alternatives include social worth criteria or some form of chance (e.g., randomization, lottery, or "first come, first treated"). Rescher (1969), pursuing this same line of thought, has suggested that there are two biomedical and three social factors relevant to final selection. Relative likelihood of successful treatment and life expectancy are the relevant biomedical factors, while the social factors include family role, potential future contributions, and past services. All of these criteria are difficult to quantify and evaluate.

At this point, it is again important to reiterate that the most critical decisions which must be confronted today are those involving the allocation of resources across health care programs (Mushkin et al., 1979). Once these decisions have been made, it will then become important to consider whether rationing will be necessary and what form it will take. It is precisely at this point that the nature and requirements of clinical decision making will become increasingly subjected to public and professional scrutiny (Wong et al., 1981; Relman, 1978; Barron, 1979). Furthermore, it is at this point that patients and their next-of-kin will become increasingly involved in the decision making process, and quantity and quality of life tradeoffs will become important (Mazzarella, 1981; McNeil et al., 1981; McNeil et al., 1982; McNeil et al., 1982). The decision making

process is well described in the literature (Crane, 1975a; 1975b; Weinstein, 1980; Wong et al., 1981; Raiffa, 1968; Keeney et al., 1976; Brett, 1981; Pauker et al., 1980; Schwartz, 1979; Ransoff et al., 1976; Reich, 1979; Eisenberg, 1979).

G. RESOURCE ALLOCATION IN PERSPECTIVE

Most discussions of resource allocation and rationing are narrowly focused and lack perspective. Attention is often directed to how health care resources are spent and not on how a reallocation of resources from other government programs might produce considerable gains in the health status of the population. Take, for example, the controversy which currently surrounds the End-Stage Renal Disease Program. This program is obviously very costly, and the benefits derived by many patients have been reported to be few (Evans et al., 1981; Gutman et al., 1981). Policymakers now question whether this program will be allowed to continue to exist in its current form (Evans et al., 1981; Kolata, 1980b).

Unfortunately, excessive attention has probably focused on the kidney program. The problems associated with delivering medical care to end-stage renal disease patients is only symptomatic of a more widespread problem--health care costs continue to escalate as a larger number of people increasingly benefit from new and expensive health care technology. However, it must be recognized that other health and social programs are equally as costly. For example, in 1981 an estimated 100,000 to 125,000 Americans underwent coronary artery bypass surgery, first performed in 1968, and the numbers continue to

rise (Randal, 1982). Yet those who have the surgery amount to only 0.04 percent of the nation's population. At $2.0 billion a year (a conservative estimate according to Randal), coronary artery bypass surgery accounts for about 1.0 percent of the total annual U.S. health bill (Drunkman et al., 1974; Stoney et al., 1978). The growth in the number of coronary artery bypass procedures performed each year has been substantial. In 1973, it was estimated that 38,000 such procedures were carried out in the U.S. at a cost in excess of $400 million (Hiatt, 1975). Collectively, coronary artery bypass surgery is the most costly operation performed in this country and has boosted private health insurance premiums for the population as a whole (Randal, 1982).

Interestingly, for most patients, the efficacy of coronary artery bypass surgery is questionable (Preston, 1977; Drunkman et al., 1974; Stoney et al., 1978; Love, 1980; Mundth et al., 1975; Lancet, 1976:841; Kolata, 1976; Braunwald, 1977; Sanz et al., 1982). There is evidence that the procedure is effective in prolonging the life of patients who suffer from a major blockage of the main trunk of the left coronary artery, but evidence of the efficacy of the procedure on patients with "three-vessel disease," or in whom all three arteries are blocked, is less clear. These patients presumably make up 30 to 40 percent of the total. Moreover, the rate of return to work among patients who have coronary artery bypass surgery is not impressive (Love, 1980; Hammermeister et al., 1979; Rimm et al., 1976; Wallwork et al., 1978; Frick et al., 1979; Barnes et al., 1977; Blumlein et al., 1977).

The costs associated with neonatal intensive care are also high and are comparable to the costs of end-stage renal disease and coronary artery bypass surgery. A recent case study on the costs and effectiveness of neonatal intensive care estimates that the average expenditures per patient in 1978 were about $8,000, with costs for some patients well over $40,000 (Burdetti et al., 1982). Since there are no national data on the volume of neonatal intensive care being delivered in the U.S., only rough estimates can be produced based on studies with small sample sizes and varying definitions of levels of care. Burdetti and associates provide the following estimates of neonatal intensive care supply and use:

1. Neonatal intensive care unit admissions--6 percent of all live births go to intensive care, accounting for 200,000 admissions each year.

2. Estimated average length of stay--8 to 18 days per patient.

3. Number of hospitals with neonatal intensive care units--600.

4. Number of intensive care beds--7500.

5. Total cost of neonatal intensive care--$1.5 billion each year.

Thus, based on the foregoing, questions being asked about the treatment of patients with ESRD could also be asked of coronary artery bypass surgery and neonatal intensive care. Since Medicare finances only a small percentage of these procedures and services (perhaps 20.0 percent nationwide in the case of coronary artery bypass surgery, with Medicaid paying for another 5.0 percent), the amount of publicity they have attracted remains small. In the case of coronary artery bypass

procedures, the majority of patients rely on third-party payers, but, even so, their out-of-pocket expenses may equal 20 percent of the total bill (Randal, 1982).

To provide even greater perspective for this discussion, the current level of defense spending as well as expenditures associated with the federal corrections system should be examined (Long, 1984; Norman, 1984). It is well recognized that the resources devoted to national defense dwarf those available to health and social programs (Hiatt, 1982). It is less well recognized, however, that it now costs as much per year to maintain a convicted felon in the federal correctional system as it does to keep a person alive on home hemodialysis. It seems a paradox that producing and maintaining the means to destroy life and warehousing in correctional facilities people who have outright taken the lives of others continues to absorb enormous resources that might justifiably be used otherwise. This has led some to ask why is it that when health care programs are criticized as being too costly, no attempt is made to put this in perspective by looking at other, less desirable uses of resources?

Table 45-8 shows budget authority and Table 45-9 budget outlays as provided in the fiscal year 1983 budget of the United States government (Office of the President, 1982). National defense expenditures are more than twice those available for government-financed health care programs. The size of the budget for the administration of justice is miniscule when compared to either the budgets for national defense or health; yet, when one examines that portion of the justice budget devoted to corrections, it is not inconsequential, considering how the

Table 45-8
Budget Authority By Function
(in billions of dollars)

	ACTUAL	ESTIMATES					
	1981	1982	1983	1984	1985	1986	1987
FUNCTION (BUDGET CODE)							
NATIONAL DEFENSE (050)	182.4	218.9	263.0	291.0	338.0	374.9	408.4
HEALTH (550)	68.9	79.2	77.8	81.4	93.6	115.7	128.3
ADMINISTRATION OF JUSTICE (750)	4.3	4.3	4.5	4.6	4.5	4.6	4.6

Table 45-9
Budget Outlays By Function
(in billions of dollars)

	ACTUAL	ESTIMATES					
	1981	1982	1983	1984	1985	1986	1987
FUNCTION (BUDGET CODE)							
NATIONAL DEFENSE (050)	159.8	187.5	221.1	253.0	292.1	331.7	364.2
HEALTH (550)	66.0	73.4	78.1	84.9	93.5	102.4	111.9
ADMINISTRATION OF JUSTICE (750)	4.7	4.5	4.6	4.6	4.5	4.5	4.6

resources are used. In 1978, the average daily population in Federal correctional facilities peaked at 29,347. Today, the average daily population has dropped to approximately 27,000. The cost per person per year (fical year 1981) for supporting people convicted of violating Federal laws as well as individuals charged with crimes and detained for trial or sentencing is approximately $13,000 ($352 million per year for 27,000 persons). Yet, as the prison population is declining, inflation is driving up the costs of operations to a point where outlays for operating correctional facilities are expected to be about $367 million in 1982 and $386 million in 1983.

Iglehart (1982) has recently summarized the 1983 fiscal year budget for major federal departments and agencies. Figures for defense and military functions and those for health and human services are reproduced in Table 45-10. In reviewing the total budget, Iglehart concluded that insofar as research and development funds are concerned, "...research in physics, engineering, and other fields with potential military and industrial applications fared considerably better than did medical research."

For fiscal year 1984, the Reagan administration requested an NIH budget of $4.1 billion, representing an increase of $73 million or 1.8 percent over last year's proposal (Long, 1984; Norman, 1984). Once the projected 4.9 percent inflation rate for 1983 is considered, however, NIH will end up losing this modest gain in terms of real dollars.

Not surprisingly, the Department of Defense (DOD) is expected to fare quite well in 1984. Since his election, President Reagan has

Table 45-10
Conduct of Research and Development in Defense and Health

DEPARTMENT OR AGENCY	OBLIGATIONS 1981	1982	1983	OUTLAYS 1981	1982	198
	(billions of dollars)					
Defense and Military Functions	16.5	20.6	24.5	25.7	18.8	22.
Health and Human Services	4.0	4.0	4.1	4.0	3.9	4.

SOURCE: Iglehart JK. Health policy report: prospects for the Nation Institutes of Health. N. Engl. J. Med. 306:879-884, 1982.

increased annual outlays for the DOD by 33 percent with plans to increase the DOD budget by another 14 percent in 1984. As of this date, the Administration has requested a total of $274 billion for DOD with some Congressmen indicating that this figure will be reduced by at least $15 billion. Overall, despite pending cuts in the DOD budget, it is still expected to increase by 30.0 percent, reaching a total of $29 billion, or 65 percent of the total U.S. budget for research and development.

In the final analysis, it is apparent that resources directed to health care programs and health-related activities are not excessive when compared with other publicly financed programs (Frederickson, 1981). At the same time, it is evident that some health care programs have been unjustly criticized when it is recognized that other medical procedures are equally as costly as those currently receiving careful scrutiny, such as the End-Stage Renal Disease Program. Thus, the following conclusion is unequivocal: resource allocation decisions must be viewed in perspective.

H. FACING THE INEVITABLE: DEATH AND DYING

As described previously, numerous ethical issues surround the allocation and rationing of health care resources. When not all will benefit, the dilemma becomes one of choosing who will. The ethical problems inherent in CBA and CEA are by no means resolved (Tancredi, 1982; Tancredi et al., 1974). It is apparent, however, that should these procedures be applied to resource allocation decisions, this

society will become acutely aware of mortality (Choron, 1964; Feifel, 1977; Becker, 1973; Maguire, 1973; Manning, 1970; Veatch, 1976).

Historically, within this society, there is a preoccupation with health, almost to the point where death is observed as the ultimate of all evil. Major social surveys of the population have continuously shown that health is highly valued (Campbell et al., 1976). Interestingly, however, it has become increasingly difficult to define the parameters of health. Even a person's need and ability to interact with others has been designated as "social health" (Donald et al., 1978; Renne, 1974; Russell, 1973). Perhaps this is because of the fact that the most commonly accepted definition of health is that provided in the Constitution of the World Health Organization, which states "...health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (World Health Organization, 1958). Consequently, at least three types of health are found in the literature--physical health, mental health, and social health. It is now difficult to determine what is and what is not health.

Preoccupation with health is obviously an unacknowledged preoccupation with death and, perhaps, the process of dying. While many people fear death, the overriding concern is with dying (i.e., the process by which death comes about). For the most part, this society appears to be fully committed to the preservation of life at all costs, despite the quality of life the afflicted is likely to lead. It has only been in recent years that clinicians and the public have been willing to straightforwardly acknowledge and verbalize their

concern with what might be called the "quantity versus quality of life tradeoff" (Crane, 1975a; 1975b; Weinstein et al., 1980; Fox et al., 1974; Bunker et al., 1977; Buck, 1981; McNeil et al., 1981; McNeil et al., 1982; McNeil et al., 1982; Reich, 1979; Sackett, 1978). Accompanying this, of course, have been open discussions of the value of human life (Rice, 1967; Rice et al., 1982; Landefeld et al., 1982; Dorfman, 1979; Lipscomb, 12979; Clarke, 1979; Fischer, 1979; Ware et al., 1979; Mooney, 1977; Culyer, 1980; 1982). The uncertainty of what follows death has led many to eschew death in favor of living, regardless of the quality of their existence. Recent studies, however, show that persons, when faced with the prospect of a long-term chronic illness, are at least willing to consider the prospects of a shorter but higher quality of life (Weinstein et al., 1980; McNeil et al., 1981; McNeil et al., 1982).

This in itself suggests that people have come to grips with the notion of death. Nevertheless, widely held religious beliefs and convictions would suggest that a large proportion of the population is unwilling to entertain the possibility of voluntary euthanasia or passive suicide as solutions to prolonged suffering (Maguire, 1973). Some religious groups would, in fact, consider life with catastrophic long-term illness an act of God and that the illness is a test of their religious conviction. In fact, they may believe that illness enhances their ability to demonstrate their religious faith to others in a testimonial fashion.

Over the years, technology has evolved to a point where the determination of death is increasingly problematic (Beecher, 1968;

Mohandas et al., 1971; President's Commission for the Study of Ethical Problems in Mediclan and Biomedical and Behavioral Research, 1981a; 1981b; Bernat et al., 1981; 1982; Stahlman et al., 1982; Capron et al., 1982; Parisi et al., 1982; Nagle, 1982). In fact, the new understanding of death is largely a consequence of technological advances in life-support systems. The President's Commission has now grappled with the problem of translating the current physiological understanding of death into acceptable statutory language. The Commission was also interested "...in the dispute between 'whole brain' and 'higher brain' formulations of death and appraising currently used brain-based tests for death, which have become increasingly varied and sophisticated" (Bernat et al., 1982). A set of guidelines has been established for the determination of death but these are not accepted by all (President's Commission for the Study of Ethical Problems in Medical and Biomedical and Behavioral Research, 1981a; 1981b; Bernat et al., 1982).

Thus, the ability of technology to stave off premature death through a variety of means makes it increasingly likely that this society will be unable to fully come to grips with death in a manner that facilitates the withholding of treatment when the expected outcomes are negligible or counterindicative to the well-being of the patient and his or her next of kin. Surprisingly, however, there is considerable interest in hospice care in the United States which, in effect, suggests that a decision to discontinue vigorous treatment is acceptable (Saunders, 1978a; 1978b; Smith et al., 1982). As described by Saunders (1978), "The hospice movement sets out to ensure that

every person who can no longer benefit from the increasing complexity of the general hospital will have the support he and his family need. The whole family is the unit of care and should also be seen as part of the caring team." By most standards, the hospice concept is not a new innovation, it dates back to as early as 1893, when St. Luke's Hospital was established in London.

Perhaps unfortunately, it is rarely the case that the similarity between hospice care and the voluntary withholding of treatment is recognized (Wong et al., 1981). The parallel is very close, yet it is presently argued that patients, under all circumstances, should receive every extraordinary means of care available in order to prolong life. Only when society is fully able to come to grips with death and dying is it likely that "policies and procedures for decisions not to treat," not only will be formulated but will also be followed. This period is likely to be hastened as financial constraints force the issue. Putting this in perspective, Manning (1970) has stated:

> Somewhere along the way, consciously or unconsciously, explicitly or implicitly, society will have to make some basic decisions about the allocation of economic resources as between human beings of advanced years and those who are younger...We have not begun to consider the violent social dislocation that would be brought about if a large fraction of the population were to be kept alive for significantly longer periods of time.

As noted previously, the problems that must be addressed are essentially ethical in nature or, perhaps, ethical-legal (McCarthy et al., 1981). New medical technology has not only dramatically changed the practice of medicine, but it has also raised a variety of issues

with which clinicians are rather uncomfortable. The problem, however, is that these issues are relatively new and must be worked through very carefully. Many of the issues surrounding the allocation and rationing of resources are almost metaphysical in nature. There is no clearcut solution to the problems they instill for society. Ethics are relative to time, place, and perhaps most importantly, culture. The anthropologist Ruth Benedict (1934), in describing the "cultural relativist" perspective on culture, made a very profound observation. She stated:

> No man ever looks at the world with pristine eyes. He sees it edited by a definite set of customs and institutions and ways of thinking. Even in his philosophical probings he cannot go behind these stereotypes; his very concepts of the true and the false will still have reference to his particular traditional customs.

The cultural relativist perspective nicely summarizes the problems inherent in making resource allocation and rationing decisions. Even though based on explicit and hopefully rational criteria, any plan that is eventually adopted is certainly debatable from the perspectives of others. To adopt a set of criteria is to make a decision about limiting treatment. On the other hand, to treat all patients with a given disorder or within a given disease category, regardless of derived benefits, necessarily implies the withholding of treatment from patients with other disorders. The question is truly one of priorities. Data can be used to set priorities, but human judgment must be exercised to determine which priorities will hold.

The future is likely to be interesting. The conscious development of explicit allocation criteria, as a first step in the direction of wisely using limited resources, will be controversial. Questions must be raised as to how resources will be allocated not only to health programs but social programs as well. There are certainly many patients with diseases and esoteric medical conditions who could benefit from additional resource allocations. In 1972, it was decided that patients with end-stage renal disease would be eligible for Medicare benefits, yet there were and are many other patients with diseases and conditions that could have sustained the prolonged attention of government agencies.

Allocation issues will obviously be submitted to a complex sociopolitical decision-making process. Decisions can be made on the basis of allocation tools such as CEA and CBA, or a grim political battle could be waged between different lobbying groups, each representing the special interests of patients with specific diseases or conditions. In either case, the first decision will be as to which patient groups will receive support (i.e., the resource allocation decision), then, as resources continue to dwindle, allocations will be made within programs and decisions will be made as to how clinicians <u>might</u> ration the limited resources made available to them. Increasingly, it is apparent that this scenario approximates the situation of the kidney disease program today. As already noted, people at all levels of government are concerned about the amount spent on the kidney program and are looking for ways to stretch what appears to be increasingly finite resources. In this regard, it could

be stated that the "battle" has just begun and that the "war" is yet to be fought.

While the dilemmas created by resource allocation and rationing decisions are undeniable, it would seem that they have and will continue to provide an impetus for a reconsideration of the meaning of death and the essence of life. Reasonably acceptable criteria have been established for the determination of death, yet the very essence of life continues to be elusive. People do seem to be on the verge of seriously valuing their lives, not only in terms of longevity but in terms of quality (Mushkin et al., 1979; McNeil et al., 1981; McNeil et al., 1982).

Although Condorset envisioned that a "...period must one day arrive when death will be nothing more than the effect either of extraordinary accidents, or the slow gradual decay of vital powers; and that the duration of the interval between the birth of man and his decay will have no assignable limit," Choron has aptly pointed out that "...the postponement of death is not a solution to the problem of the fear of death...there still will remain the fear of dying prematurely" (Choron, 1964).

In his treatise on death, Ernst Becker shows that the fear of death is universal and this fear "...haunts the human animal like nothing else; it is a mainspring of human activity--activity designed largely to avoid the fatality of death, to overcome it by denying in some way that it is the final destiny of man" (Becker, 1973). He argues that far too much effort is put into establishing immortality, in his words, into establishing a "formula for triumphing over life's

limitations." People have failed to take life and its limitations seriously. He concludes his discourse, as follows, with a challenge for those who have used science to define the very essence of life (Becker, 1973):

> The problem with all the scientific manipulators is that somehow they don't take life seriously enough; in this sense, all science is "bourgeois," an affair of bureaucrats. I think that taking life seriously means something such as this: that whatever man does on this planet has to be done in the lived truth of the terror of creation, of the grotesque, of the rumble of panic underneath everything. Otherwise it is false. Whatever is achieved must be achieved from within the subjective energies of creatures, without deadening, with the full exercise of passion, of vision, of pain, of fear, and of sorrow. How do we know that our part of the meaning of the universe might not be a rhythm in sorrow?

Had Becker devoted his attention to an analysis of the full implications of life-prolonging advanced biomedical technology, it is difficult to speculate what he would have concluded. It is quite likely, however, that he would have concluded that western society has become too infatuated with the fear of death and has failed to realize the true essence and value of life, despite its length.

I. DISCUSSION

I have attempted to put modern technology into perspective by noting that technological innovation is in response to the demand created by the increased life expectancy and changing age distribution of the population and the increased prevalence of chronic disease and its concomitant disability. Increasingly, it is recognized that sophisticated medical technology, however, is not without its price.

In recent years, it has been argued that technology has been a major contributor to rising health care costs in this country. Whether technology will continue to be viewed as the culprit behind rising health care costs is yet to be seen.

Efforts are now being made to control technology by a more thorough, comprehensive, and ongoing assessment of new, emerging, and existing technological innovations (Banta et al., 1981; McNeil et al., 1982; Council for Science and Society, 1982; Editorial, 1983:279; Omenn et al., 1978; Sun, 1983; Perry, 1982a; 1982b; Banta, 1982; Evans et al., 1982). In this regard, Relman has correctly argued that one effective method of moderating the cost of medical care, while improving its quality, is to initiate "a major new national program of support for the evaluation of medical procedures of all kinds..." (Relman, 1980). From his perspective, it is the cost of ignorance associated with medical technology that is too great, not medical progress. In Relman's words, "The cost culprit is not technology per se, but only technology that is ineffective, superfluous, or unsafe" (Bernat et al., 1982; Blumenthal et al., 1982). In short, the goal of technological assessment should not be to curb the development of technologies but rather to provide the means for an unbiased evaluation of new technology before it becomes too widely diffused in practice. To meet this goal, Bunker and his associates have proposed the establishment of a private, nonprofit corporation for the collection, analysis, and dissemination of data on medical procedures and for the support of new clinical trials (Bunker et al., 1982a; 1982b). The Institute for Health Care Evaluation, as they refer to it, would be

intended to partially fill the void created by the abolition of the ill-fated National Center for Health Care Technology (Relman, 1982). This Institute would have neither policy-making or regulatory functions. At the present time the Health Care Financing Administration (HCFA) has taken on an increasingly visible role in the assessment and regulation of new health care technology (Schaeffer, 1982). This role is evidenced by two generic types of policy decisions which HCFA must make, namely: (1) coverage decisions--whether or not an item or service is one for which the program can pay--and (2) reimbursement decisions--How much is appropriate to pay for a covered item or service.

Despite Bunker's proposal for an Institute for Health Care Evaluation and the remarkable and noteworthy efforts of the Office of Technology Assessment, the foregoing discussion concludes that technological assessment, although likely to increase the efficiency of the health care delivery system, will not be sufficient to wholly resolve impending budgetary constraints. There are, indeed, limitations on the resources that can be allocated to health care programs, although some reallocation decisions would serve to stave off the inevitable. In preparation for the inevitable, plans must be made and techniques developed for the effective allocation and rationing of health care resources. Various suggestions have been offered as to how cost-effectiveness and cost-benefit analytic techniques can be applied to the making of intraprogram and interprogram <u>allocation</u> decisions. Clinical decision analysis,

although imperfect, is offered as a possible approach to dealing with the resource rationing dilemma.

The increasingly apparent need to allocate and ration health care resources has led to a careful scrutiny of medical care costs. Health economists continue to point out that health care costs are almost out of control and that a major solution to this problem is to make the current service delivery system more efficient through various competitive strategies, despite the fact that recent reports indicate that competition can have a negative impact upon the quality of care patients receive (Office of Technology Assessment, 1982). Taking a differing viewpoint, other commentators have correctly pointed out that the health care industry, employing approximately 4.3 million workers, is the second largest industry in the U.S. and that reductions in health care through competition or other strategies would serve to displace a large number of people in this industry (Le Maitre, 1982). The effect would be very dramatic as displaced health care workers "...would either displace others from their jobs or go on the welfare rolls. Either way one looks at it, a shrinkage of the health-care industry would create a ripple effect throughout our economy" (La Maitre, 1982). This has led Kolff to suggest that efforts to control health care costs through careful technology assessment "...totally neglects the notion that we should move towards a service oriented economy instead of towards an industrial production directed economy" (W.J. Kolff, M.D., Ph.D., written communication, February 22, 1983). He asks, "What are we to do with our unemployed? Unless we expand our 'services,' there is no solution."

The causes and cure of medical cost inflation are only partially understood and, thus, remain debatable. Jellinek and others, however, feel there are factors other than the "delivery of health care or the marketing of illness" which have led to increased spending in the health care sector (Le Maitre, 1982; Jellinek, 1982a; 1982b; Lee, 1982). Jellinek believes the continued rise in health care expenditures is a result of increased alienation and depersonalization associated with post-World War II society (Jellinek, 1982). The response of society is to compensate by aggressive attention to the individual when he or she becomes ill. Jellinek summarizes his position as follows (Jellinek, 1982):

> Societal willingness to support extraordinarily expensive new medical technology and advanced training, which implicitly communicates a willingness to place a high value on individual human life in contrast to the low value implied by industrial depersonalization, may represent one important form of adjustment of the social contract. The increase in society's expenditures for medical care may constitute a stabilizing force necessary to counter the destabilizing impulses generated by continued economic development.

In the final analysis, however, perhaps Jellinek's assessment of the problem does not go far enough (Jellinek, 1982). For example, it seems almost a paradox that defense spending goes unchecked while at the same time massive cuts have been made in public health care assistance programs, as well as health care research efforts. While public fund-raising efforts may produce the required resources to enable a young child to receive a liver transplant or a middle-aged person to obtain a heart transplant, to date, there remains relatively

little public debate over the merits of increased defense expenditures, which obviously pale current health care expenditures.

Unfortunately, the lay public, nevertheless, seems to be either unaware of, or has chosen to ignore, the key ethical issues implied by resource allocation and rationing decisions. Perhaps not uncharacteristically, people remain willing to come to the aid of identifiable victims of resource scarcity, such as people in need of organ transplants. At the same time, the lay public finds a special attraction in people such as artificial heart recipient Barney Clark, who has been honored for "risking his life in order to save it." Thus, in the end, perhaps, the real concern with personal health in today's society is not so much the depersonalization and alienation that many people feel but rather the fact that destructive forces of an unprecedented magnitude have served to completely threaten human existence (Weinberger, 1982; Relman, 1982; Caldicott et al., 1983). Consequently, for many people, the true value of life becomes most apparent either when an individual's life is at stake because they are denied medical care which is available but in short supply or when the type of medical care required is unavailable. Although often highly publicized by the mass media, each of the patients who fall into these categories serves to underscore the basic dilemma--health care resources are limited.

The inevitability of resource allocation and rationing decisions has been well-characterized by Fuchs (1974). In his discussion of the problems of health and medical care, he notes that an economic approach to these is firmly rooted in three fundamental observations

of the world. These are as follows: (1) resources are scarce in relation to human wants, (2) resources have alternative uses, and (3) people have different wants, with considerable variation in the relative importance they attach to them. Yet the basic economic problem identified by Fuchs is "how to allocate scarce resources so as to best satisfy human wants" (Fuchs, 1974).

While Fuchs places a great deal of emphasis on the economics of resource allocation and provides only cursory attention to the social, ethical, and legal implications of allocation and rationing decisions, the fact is that without economic constraints, most allocation and rationing decisions would be unnecessary except in situations where the needed resource, natural or otherwise, is severely limited. In instances of the latter, economic resources would not be sufficient to alleviate scarcity. The basic premise of this discussion, therefore, is that constraints on economic resources will necessitate resource-allocation and rationing decisions, which, in turn, will make the confrontation of various social, ethical, and legal issues inescapable. In the future, the major issues confronting not only medicine but this society as a whole will be the social, ethical, and legal implications of resource allocation and rationing whether framed in terms of distributive justice, (Rawls, 1971; Soltan, 1982; Branson, 1978; Bayer et al., 1983; Daniels, 1981; Feinberg, 1978; Daniels, 1975), discrimination against the poor and disadvantaged, (Piven et al., 1971), or the withholding of treatment from those with catastrophic illness (Wong et al., 1981). All of these share a common underlying theme, the need to confront human finality and purposeful existence (Jonsen, 1976).

As described herein, the problems associated with the allocation and rationing of scarce medical resources, economic (e.g., health care dollars) or natural (e.g., organs and tissue for transplantation) are, indeed, very related to dying as an experience and death as an event. This discriminatory use of resources (and that is basically what allocation and rationing imply), has a lot to do with the fact that individuals are eventually denied something they require--in this case, medical care. Schelling (1968) underscores the essential ingredient of rationing decisions when he distinguishes between an "individual death/life" and a "statistical death/life." The two are, in reality, different and he provides the following example to illustrate his point:

> Let a 6-year old girl with brown hair need thousands of dollars for an operation that will prolong her life until Christmas, and the post office will be swamped with nickels and dimes to save her. But let it be reported that without a sales tax the hospital facilities of Massachusetts will deteriorate and cause a barely perceptable increase in preventable deaths--not many will drop a tear or reach for their checkbooks.

This distinction is an important one because it highlights the fact that the death of an individual is a unique, often private event. Yet, at the local level, the victim and his or her family have an intense interest. In fact, as Schelling (1968) notes, if society takes an interest in a local death, it is often because of a general concern that "reasonable efforts are made to conserve life than in whether those efforts succeed."

At this point in time, it is predictable that resource allocation decisions are unlikely to be carefully scrutinized by the public until

resource rationing decisions become an inescapable fact of life. When the public is exposed to rationing decisions that it feels are contrary to the interest of the persons involved, despite catastrophic illness, it is likely to call into question the worthiness of allocation decisions. When it becomes apparent that these decisions are based on a mix of medical and social criteria, the latter which the public is much more likely to understand and despise as the basis for differentially valuing human life, the public will become increasingly irritated and resentful.

While selection criteria of any sort are likely to be viewed as unjust, it is a truism that not all people are likely to maximally or optimally benefit from available medical technology. For example, I and associates have shown how dramatically the extension of Medicare benefits to patients with ESRD affected the composition of the patient population (Evans et al., 1981). In particular, indicia of patient rehabilitation, such as employment status, show a decline in the overall status of the patient population.

In the future, decisions must be made concerning which patients will maximally and optimally benefit from expensive health care technology, yet a watchful person must focus on such decisions to assure that "social worth" will not be the criterion of final determination. The problem, however, is that, in many respects, social and medical criteria are inextricably intertwined. People of low socioeconomic status are likely to be in poorer health with multiple disease conditions, which, in part, reflects poor nutritional habits, detrimental lifestyle, and the historical lack of resources to

obtain proper health care. Consequently, if medical criteria were to be the basis upon which rationing decisions are made, they might exclude the poor and disadvantaged because health and socioeconomic status are highly interdependent. For example, it is not unusual to find that of those persons with ESRD, those of lower socioeconomic status are likely to have multiple comorbid health conditions such as diabetes, hepatitis, and hypertension. Not only are these patients less desirable candidates for dialysis and transplantation, but they are among the more expensive patients to treat.

Without careful planning and evaluation, the cleavage between the haves and have-nots, as evidenced by formal selection criteria, is likely to become substantial. Those with the financial means may be able to purchase the services they require, while those who are disadvantaged and destitute will be denied care. Claims of a right to health care might well serve as a common goal to bind the disenfranchised (Bell, 1979; Englehardt, 1979; Beauchamp et al., 1979; Childress, 1979; Siegler, 1979; Veatch, 1979; Daniels, 1979; Ruddick, 1979; McCullough, 1979). Specific laws have been promulgated to protect the rights of certain classes of persons; examples include Section 504 of the Rehabilitation Act of 1973, the Age Discrimination Act, and Title VII of the Civil Rights Act (Weir, 1983; Pless, 1983; Angell, 1983; Hefferman, 1984; Holden, 1984; Annas, 1984). Each of these laws has important implications for resource rationing decisions.

It is highly probable that disclosure of the names, by the media, of persons who have been denied the benefits of medicine will set into motion complex sociopolitical manuevering to reprieve those who have

reportedly been treated unjustly by those with authority to make and enforce resource-rationing decisions (Abram and Wolf, 1984). Arguments which surround these decisions are likely to be very similar to those made in connection with abortion and the withholding of medical treatment (Wong et al., 1981; Relman, 1978; Barron, 1979; Curran, 1978; Relman, 1979; Glantz et al., 1979). The Quinlan, Saikewicz, and Dinnerstein cases will frequently be cited as precedent-setting. Analogies are likely to be made between current events and the events that took place in Nazi Germany. To this end, it will be argued that to set forth criteria which deny people treatment, in effect, represents a devaluation of life. As Carroll (1970) has noted:

> Life has become increasingly cheap in our time. Today, Aushwitz and Dachau are museums; Coventry, Dresden, and Hiroshima, vague memories; the deaths several years ago of hundreds of thousands of Indonesians, a footnote to history; race riots in American cities, a subject of study; and war casualties in Viet Nam, an object of routine reports.

Moreover, the practice of rationing will bring forth cries that the precedent is now set for the "floodgates to be opened" to the "mass slaughter" of persons whom rationing criteria declare to be of "marginal" value.

The point of the matter, however, is that rationing decisions are already being made (Weinstein et al., 1976). The fact that they are not publicized has prevented them from becoming a social issue despite the fact that they have attracted the attention of bioethicists (Crane, 1975a; 1975b; Jonsen et al., 1982; Culver et al., 1982).

Nevertheless, the future is likely to be filled with accounts of people who have been refused treatment. Within a society that has failed to come to grips with the meaning of death and the essence of life, rationing decisions will appear unusually cruel. Yet when these decisions are acknowledged as inescapable, this society, this culture, will be more prepared to deal with the one event which is truly inevitable--death.

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NATIONAL HEART TRANSPLANTATION STUDY

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